THE INTRODUCTION OF METALLURGY INTO INDONESIA: A COMPARATIVE STUDY WITH SPECIAL REFERENCE TO GILIMANUK

By

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Declaration

Except where otherwise indicated
this thesis is my own work

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Abstract

This research is aimed at giving a broad explanation for the introduction and development of ancient metalworking in Indonesia. The first appearance of metal objects (copper, bronze, iron, and gold) in Indonesia at ca. 2500-2000 BP (van Heekeren 1975:51; Glover and Syme 1993:41) is believed to have reflected the influence of metallurgical centres on the mainland of Southeast Asia, through trade and exchange (Higham 1988:143-4; Bellwood 1997:268; see also Soejono 1977:10). So far, comparisons of morphology and decoration of certain kinds of metal artefacts (e.g. bronze drums) have informed most of the discussion about the sources of such influence. But it is now necessary to expand the enquiry further, to include stored fragments of metal specimens from recent excavations in Indonesia.

The specimens examined in my research have been excavated mainly in Gilimanuk, western tip of Bali, from the 1963 to 1997 excavations. They are now stored in the National Research Centre of Archaeology Jakarta and Bali offices. The items are mostly various forms of bronze axes and pointed implements buried as grave goods, together with other items such as iron weapons, gold ornaments, glass beads, pottery, and skeletal remains of animals (see Soejono 1979). My research is focused on the variations of morphology and size in these artefacts. Other early metal sites, such as Plawangan on the north coast of Central Java and Pasir Angin in inland western Java, have some similar artefacts and are brought into the analysis for purposes of comparison.

The Gilimanuk bronze axes that were classified by Soejono as types V-A, V-B and VI (Soejono 1977) are an important subject of debate. While Soejono suggested that they are all Balinese local types that were manufactured in inland Bali as trading commodities, current research shows similarities within the wider Southeast Asian region. The type V and VI axes/points are paralleled to some degree in the bronze tools excavated in central Thailand from the Khao Wong Prachan sites, particularly Nil Kham Heng.

The results of comparison with other Early Metal Phase sites show that, while the Pasir Angin metal specimens have some similarities with Gilimanuk, a

remarkable difference appears in Plawangan is that iron was more common during this period. The absence of metal sources in Bali and the demand for bronze objects possibly encouraged high levels of importation that finally motivated the local development of metalworking focused on bronze rather than iron. Moreover, indications of local mining and ore reduction, as opposed to casting (which can use scrap metal or imported ingots) have never been recovered in Bali. Comparisons of chemical components indicate that some of the Gilimanuk bronze objects contain high percentages of tin, comparable to objects from the Late Period at Ban Chiang in northeastern Thailand.

The results of my examination of the Gilimanuk axes show that three additional variants within the Soejono type V are recognisable. The small Variant 2, mostly under 2.0 cm long, is quite frequent, and being so small it might reflect a need to conserve scarce raw materials in the production process. The variants of type V axes and some other distinct metal specimens indicate the ability to develop and modify metalworking locally. In this case, the role of coastal sites in the exchange system that motivated the emergence of small-scale metalworking in these regions is also indicated.

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CHAPTER 1

INTRODUCTION

RESEARCH BACKGROUND

The first appearance of metal objects (copper, bronze and iron) in the Indonesian archipelago is believed to have occurred between approximately 2500 and 2000 BP (van Heekeren 1975:51; Glover and Syme 1993:41). It is assumed that metallurgy was introduced externally from some regions of mainland Southeast Asia, such as Thailand and Vietnam, and from India and China (van Heekeren 1958:2; Bellwood 1997:268). An exchange system has been suggested as a transmitter for the spread of metallurgy (Higham 1988:143-4).

Cupreous objects such as kettledrums, socketed axes and hoes, daggers, vessels, ornaments and figurines, together with a wide range of iron objects such as bracelets, axes, hoes and a few gold ornaments, have been found in many sites in Indonesia. Some were retrieved through systematic excavation but most are accidental discoveries. Excavations in several sites, such as Anyar (northwest coast of Java), Pasir Angin (inland West Java), Plawangan (north coast of Central Java), Gilimanuk (west coast of Bali), Sembiran (north coast of Bali), and Leang Buidane and other sites in the Talaud Islands, have yielded metal objects in relatively good archaeological contexts.

The sporadic appearance of metal items has been claimed to indicate the beginning of the final stage of the prehistoric period in Indonesia, which was accompanied by an elaboration of many kinds of craft working (*Masa Perundagian* in Indonesian) (Soejono 1990). Van Heekeren (1958:1) claimed that the appearance of socketed axes indicated 'the final phase of the Bronze Age or the beginning of the Iron Age', and proposed the term Bronze-Iron Age for the ultimate stage of Indonesian prehistory. But many scholars such as Glover and Syme (1993: 63) argue that the crucial problem in studying the Early Metal period of Indonesia is that 'most of the finds are unprovenanced and of an uncertain date'. This situation causes difficulties in tracing 'metalworking continuities in Peninsular Malaya and Indonesia'

(Glover and Syme 1993:63). Because of the dating problem, Bellwood (1997:269) reminds us that '...many assemblages considered to be "Bronze-Iron Age" in the terminology of Heekeren (1958) could quite easily be fully historical...'.

Pure unalloyed copper items were once assumed never to have been used in Indonesia during the Early Metal period (van Heekeren 1958:1; Soejono 1990: 243). Ideally, more analyses on chemical composition should be done to clarify this assumption. However, using X-ray fluorescence analysis, a socketed axe and 'a hollow cone-shaped item' from the Leang Buidane jar burial deposit on Salebabu Island (ca. AD 500-1000) were identified as of copper and bronze respectively (Bellwood 1976:417-8). Those objects were found with three baked-clay fragments of casting moulds for axes and fragments of metal bracelets, not yet analysed (Bellwood 1976:417-8).

Unfortunately, microscopic analysis to assess the chemical composition of the metal objects discussed in this thesis could not be carried out as part of my research, owing to the lack of suitable facilities in Canberra. So, the term "bronze" is used in this paper to refer to all metal objects with similar cupreous characteristics whether alloyed or not. Cupreous objects are shiny red-brown or yellow brown in colour when new, and show light to dark green corrosion with age.

Gilimanuk on the southern shoreline of Gilimanuk Bay on the western tip of Bali Island, is one of the most important Early Metal Phase sites in Indonesia. Lots of important well-preserved finds, including metal artefacts, have been discovered in a series of excavations since 1963. The bronze implements from Gilimanuk, including socketed axes and hoes, arm and leg bracelets, earrings and pentagonal plates, were mostly associated with human skeletons as funeral gifts (Soejono 1977:182). The appearance of metal objects in Gilimanuk and other sites in Bali showed that the Balinese absorbed technology introduced from other areas and developed it internally (see Soejono 1977: 10). This assumption is supported by the occurrence of pieces of stone mould for casting an Indonesian type of bronze kettle drum (the Pejeng type) at Manuaba (see Soejono 1977:12, Soejono 1990). In addition, a similar stone mould fragment was also found at Sembiran (Ardika 1991:130).

In the case of Gilimanuk, a full examination of the metal finds still needs to be undertaken. This is because previous investigations into the Gilimanuk metal finds have not involved all the objects, which consist not only of finished artefacts of bronze, iron and gold, but also non-artefactual items, such as iron and copper slag. Soejono (1977:273) argued that the presence of copper slag in Gilimanuk was not convincing support for the occurrence of metalworking in Gilimanuk, due to the absence of crucibles.

It has been suggested that the absence of metal sources in Bali was overcome by an external exchange system (Soejono 1977:275; Ardika 1987:5, 25; Ardika 1991:132). The possibility of an exchange system involving Bali is supported by not only metal objects, but also by glass beads and rouletted wares (see Ardika 1987; 1991). It has also been suggested that many of the bronze axes unearthed in Gilimanuk were manufactured in inland Bali (see Soejono 1977:273, Ardika 1987:31). However, one problem here is that indications of bronze axe casting moulds have not yet been found anywhere in Bali (see Aziz 1983:140). The suggestion that the Gilimanuk metal objects were obtained from inland sites is difficult to prove and based on poor dating and, other questions include the role of coastal sites such as Gilimanuk in the introduction of metallurgy into Indonesia.

Bronze axes were the most frequently occurring items among the Gilimanuk metal objects. Those axes, together with similar items from other regions in Indonesia, have been classified by Soejono (1972) according to 'characteristic features of shaft and blade'. Earlier classifications by van der Hoop (1941, cited in Soejono 1972) and van Heekeren (1958) were unsatisfactory due to the inconsistent use of categories (Soejono 1972). In his attempt, Soejono (1980:372) ignored minor shape deviations 'to avoid undue complication of the classificatory system'. Concerning the dispersal of bronze axes, Soejono (1980:372) argued: '...certain varieties have been manufactured in restricted areas and others came to be preferred for wider distribution'. He also suggested that several bronze axe types from Gilimanuk would be regarded as local to Bali (Soejono 1977:10-11).

In relation to the introduction of metallurgy into the Indonesian archipelago, Gilimanuk seems to occupy a special place. While metal sources are absent in Bali, a number of local types of bronze object are claimed to be abundant in this site. To verify this, it will be necessary to compare the bronze artefacts from Gilimanuk with those from other Southeast Asian sites. Glover and Syme (1993) have observed that similarities can be seen among bronze axes across wide regions of Southeast Asia. Socketed bronze axes have been called 'the 'guide-fossils' of Dongsonian culture', but have never been used in Western Asia or India (Bernet Kempers 1988:289, 292).

My comparative study will also relate Gilimanuk to other Early Metal Phase sites in Indonesia, especially Plawangan, Pasir Angin and Sembiran. These sites not only revealed metal artefacts, but also indications of on-site metalworking, the significance of which is rarely noted. The locations of these sites, mostly in coastal areas, are important in order to trace inter-island contacts and the changing patterns of material culture style across the archipelago.

RESEARCH AIMS AND SCOPE

Because of the importance of the finds there, the sites of Gilimanuk and Plawangan have absorbed greater attention than any of the others. Regular excavations continue to be done in both sites and many aspects of early Gilimanuk and Plawangan culture, for instance the use of animals as funeral gifts (see Permana 1990), and aspects of technology, demography, cultural ecology (see Ramelan 1990) and geomorphology, have been discussed. The bronze objects from the 1973-77 excavations at Gilimanuk were discussed by Aziz (1986) in relation to burial methods. The function of the Gilimanuk site has also come into debate. Was it both a burial and settlement site, or solely a burial site (see e.g. Ramelan 1988; Aziz 1996) ?

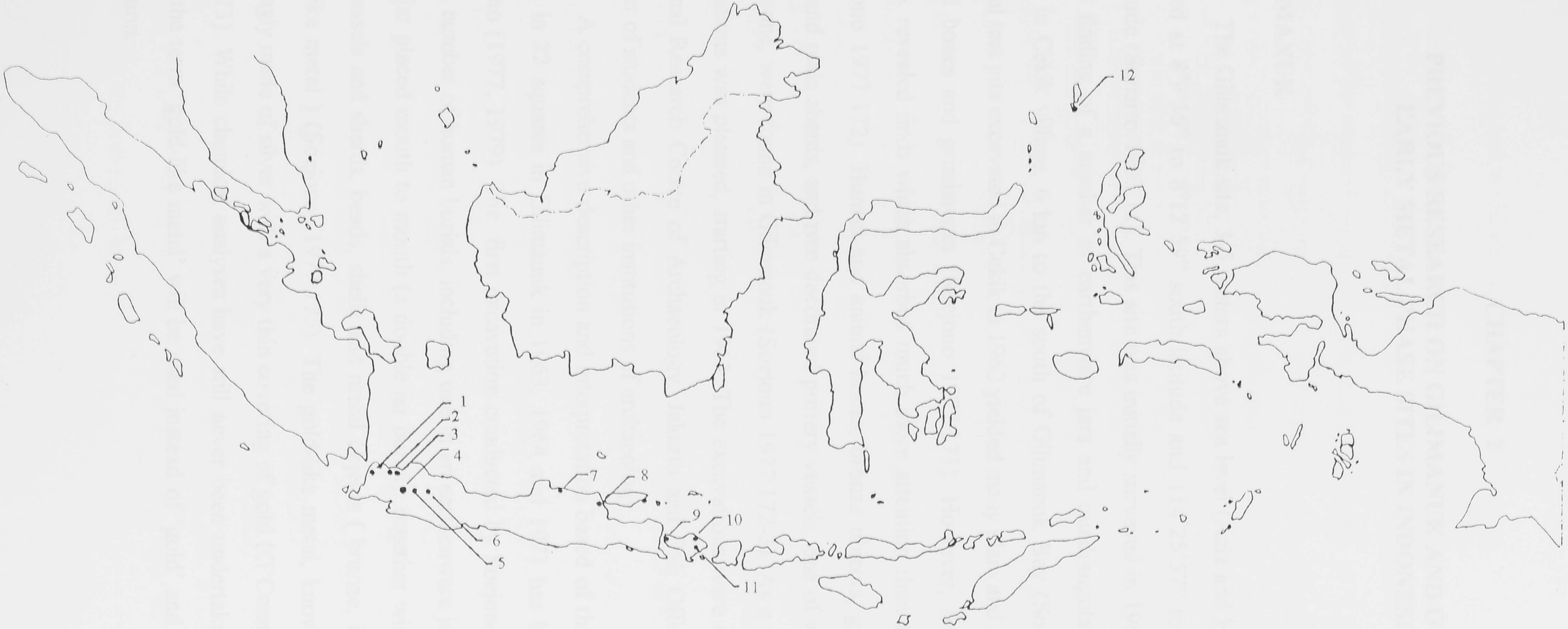
Different from former investigations, my research attempts to give a broader explanation of the introduction and development of metal working in Indonesian prehistoric society, particularly based on archaeological research in Gilimanuk compared with other Early Metal Phase sites in the islands and mainland of Southeast Asia. Metal artefacts from these sites will be examined and the possibility of the occurrence of on-site metal working will be discussed. In this regard, macroscopic analysis of metal objects from Gilimanuk, especially the bronze axes, is expected to be able to reveal evidence for activities other than burial. The role of coastal sites in the exchange system that motivated the emergence of metal working in Indonesia is also important. Observations on other finds, such as pottery and beads, are necessary for analysing the exchange system.

A brief description of the results of excavations by Indonesian archaeologists in Gilimanuk and other Early Metal Phase sites will be given in Chapter 2. Chapter 3 contains the re-examination of Gilimanuk metal objects and comparison with specimens from other sites. Other Early Metal Age sites in the islands and mainland of Southeast Asia are discussed in Chapter 4, in relation to the development and spread of metallurgy and the nature of metal usage and implications for socio-economic activities. The role of Indonesian coastal sites in long distance exchange will also be discussed in this chapter. Conclusions about the introduction of metallurgy into Indonesia and future research needs will be presented in the fifth chapter.

DATA COLLECTION

The artefacts examined directly are all metal objects excavated from Gilimanuk in 1963, 1964, 1973, 1977, 1979, 1984 to 1986, and 1990 to 1997. They are kept in the National Research Centre of Archaeology, Jakarta and Bali branches, and in the Gilimanuk Museum. However, not all of the metal objects uncovered in all the squares of the excavations can be examined directly. This is because some items appear to be lost. Moreover, some items supposed to derive from the excavations are unlabelled, or labeled but without complete information about the squares (called sectors) and spits or layers where they were originally recovered. Such objects are displayed in the National Museum in Jakarta and in the Gilimanuk Museum. Gold objects, meanwhile, can only be known from photos and excavation reports. Consequently, examination was only undertaken of the metal objects with complete information, which were mostly from the 1964 excavations. These consist of more than 258 pieces of complete and fragmentary bronze and iron objects. Information from published and unpublished reports on the site in Indonesia will also be included in the discussion.

Metal artefacts and the indications of metalworking from other sites are mainly studied indirectly from secondary resources. Non-metal artefacts found in these sites, especially pottery and beads, are also discussed. Some metal and non-metal specimens from Plawangan that can directly be observed are in the collections of the National Research Centre of Archaeology in Jakarta. In addition, some pottery sherds from Gilimanuk kept in the National Research Centre of Archaeology in Jakarta, have been analysed by me under a Scanning Electron Microscope to provide information on composition.



1.1. Map showing the Early Indonesian Metal Phase sites discussed in this thesis: 1. Anyar; 2. Pejaten; 3. Buni; 4. Pasir Angin; 5. Bandung; 6. Kuningan; 7. Plawangan; 8. Kradenanrejo; 9. Gilimanuk; 10. Sembiran; 11. Manuaba; 12. Leang Buidane.

CHAPTER 2

PREVIOUS RESEARCH ON GILIMANUK AND OTHER EARLY METAL PHASE SITES IN INDONESIA

GILIMANUK

The Gilimanuk site, 3-5 meters above sea level (Aziz and Faisal 1997:53), is situated at 8°9'36" to 8°12'59" south latitude and 114°25'57" to 114°29'10" east longitude (Sunarto 1993:11). This site was initially surveyed in 1962, alter the accidental finding of a number of earthenware jars and quadrangular-sectioned stone adzes in Cekik village, 6 km to the south of Gilimanuk Bay (Soejono 1977:170). Several test pits excavated in Cekik in 1962 yielded many plain and decorated sherds, animal bones and grindstones (Soejono 1977:171). However, the survey in Gilimanuk revealed finds which absorbed much more attention than those from Cekik (Soejono 1977:172). Human and animal bones, bronze objects, glass beads, decorated and plain sherds, and two decorated pottery vessels, one of which contained a grindstone, were found in Gilimanuk (Soejono 1977:172-3). As a result, a series of excavations was planned, starting in 1963. The excavations were conducted by the National Research Centre of Archaeology, Jakarta and Bali Offices, involving a number of students and other institutions of archaeology.

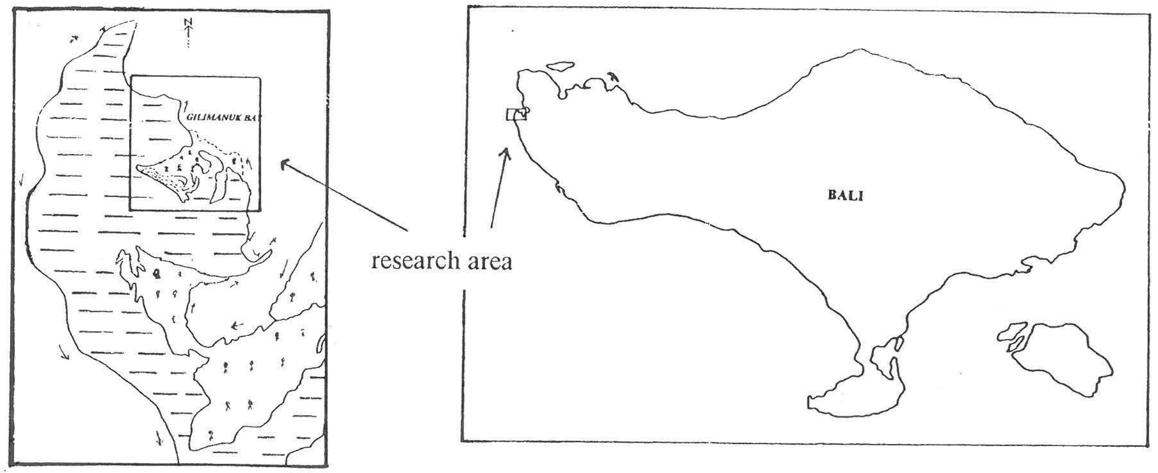
A comprehensive description and interpretation based of the results of excavation in 22 squares in Gilimanuk in 1963, 1964 and 1973 has been provided by Soejono (1977, 1979). The first excavation conducted by Soejono in 1963 uncovered a number of human burials, including one in an earthenware jar covered by another jar placed mouth to mouth (a double jar burial), together with numerous pottery vessels and sherds, beads, shells and metal objects (bronze, iron, and gold or gold-like metal) (Soejono, 1977:175). The gold-like metal, known as *suasa*, was seemingly made of silver with a very thin covering of gold (O'Connor and Harrisson 1971:73). While chemical analyses have still never been undertaken on these artefacts, the term 'gold-like metal' will be used instead of 'gold' and '*suasa*' to avoid confusion.

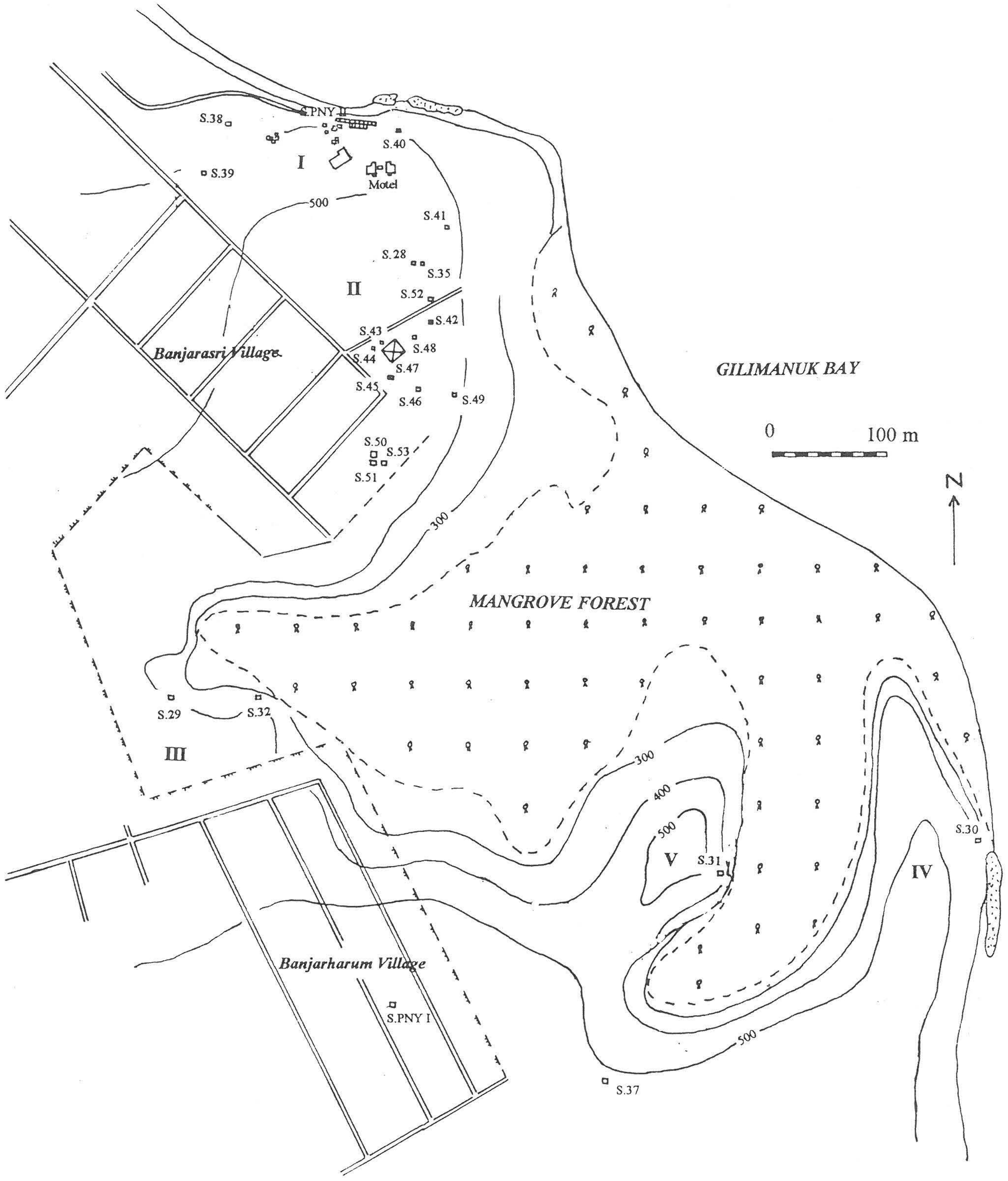
Methods of Excavation, Stratigraphy and Geomorphology

Covering an area of approximately 2 square km (Ramelan 1988: 3), the Gilimanuk site has been divided into five zones based on the existence of five sand spits deposited by the ocean (Verstappen 1974, cited in Soejono 1977:281, map 38; Soegondho 1995:15; see figure 2.1, 2.2). The excavations in Gilimanuk were done in square units (Soejono 1979:189) and each square was called a sector. Up to 1997, sixty squares were excavated: thirty-four located in zone I, twenty in zone II, and three, two and one in zones III, IV and V respectively (Puslit Arkenas 1990; Yuliati 1997a). Soejono (1977:281) asserted that zones I and II contained the densest finds.

The site grids was laid out in 3 metre squares but most of the trenches were 2.5 meters by 2.5 meters in sizes with baulks one metre wide left between them (Soejono, 1977:174). Squares S.LIV, S.LV, S.LVI, S.LVII and S.LVIII were only 2 meters by 2 meters (Yuliati 1996/97; Yuliati 1997a). Each square was further divided into smaller squares, each 50 cm by 50 cm. Recording and labeling of each find was based on spits, but before 1973 on natural layers. Each spit was usually 10 cm thick, starting with a surface spit 15 cm thick. The average depth of each trench was 2 meters, which according to Soejono (1977:177-9; 1979:191-2) revealed a sequence of four archaeological layers.

1. A black humus, with an average thickness of 20 cm, disturbed by recent activities and containing recent materials such as iron tools and porcelain, along with sherds and shells mixed from lower levels.
2. A yellow-grey fine grained soil with an average thickness of 15 cm, containing shells, sherds and pigs bones.
3. A light to dark brown mixture of clay and sand varying in thickness between 75 and 150 cm. This layer contained a large number of sherds and shells, fragments of metal objects, personal ornaments and earthenware vessels. Bones of pig, fowl and fish were also found in this layer, while human burials were recovered in several squares. The density of sherds and shells gradually decreased towards to the bottom.
4. A light grey sand containing burials, along with funeral gifts, at about 75 cm below the top of the layer. Some sherds and shells found in this layer are believed to have intruded from the occupation layer 3 above.





Legend:

I - V : zones of excavation

□ : excavation square (2.5x2.5 m^2 or 2x2 m^2)

═ : roads

ᴨᴨ ᴨᴨ : recent settlement border

- - - : border of mangrove forest

⊠ : museum

: school

: coral reef

Figure 2.1. Map of Gilimanuk and Excavated Areas
(from Laporan Penelitian Arkeologi Gilimanuk 1995/6; Sunarto 1993 figure 3.8, with some modifications)

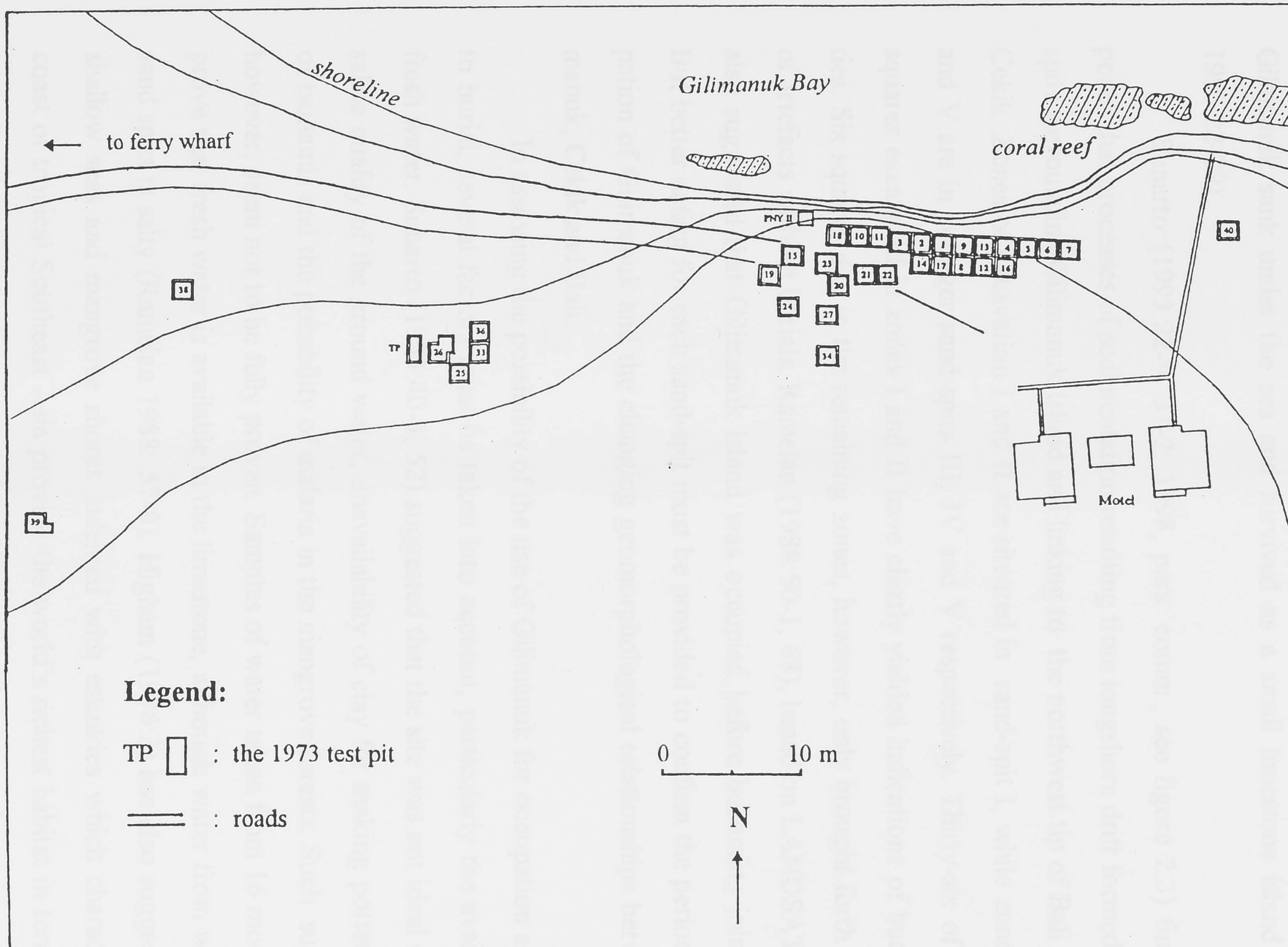
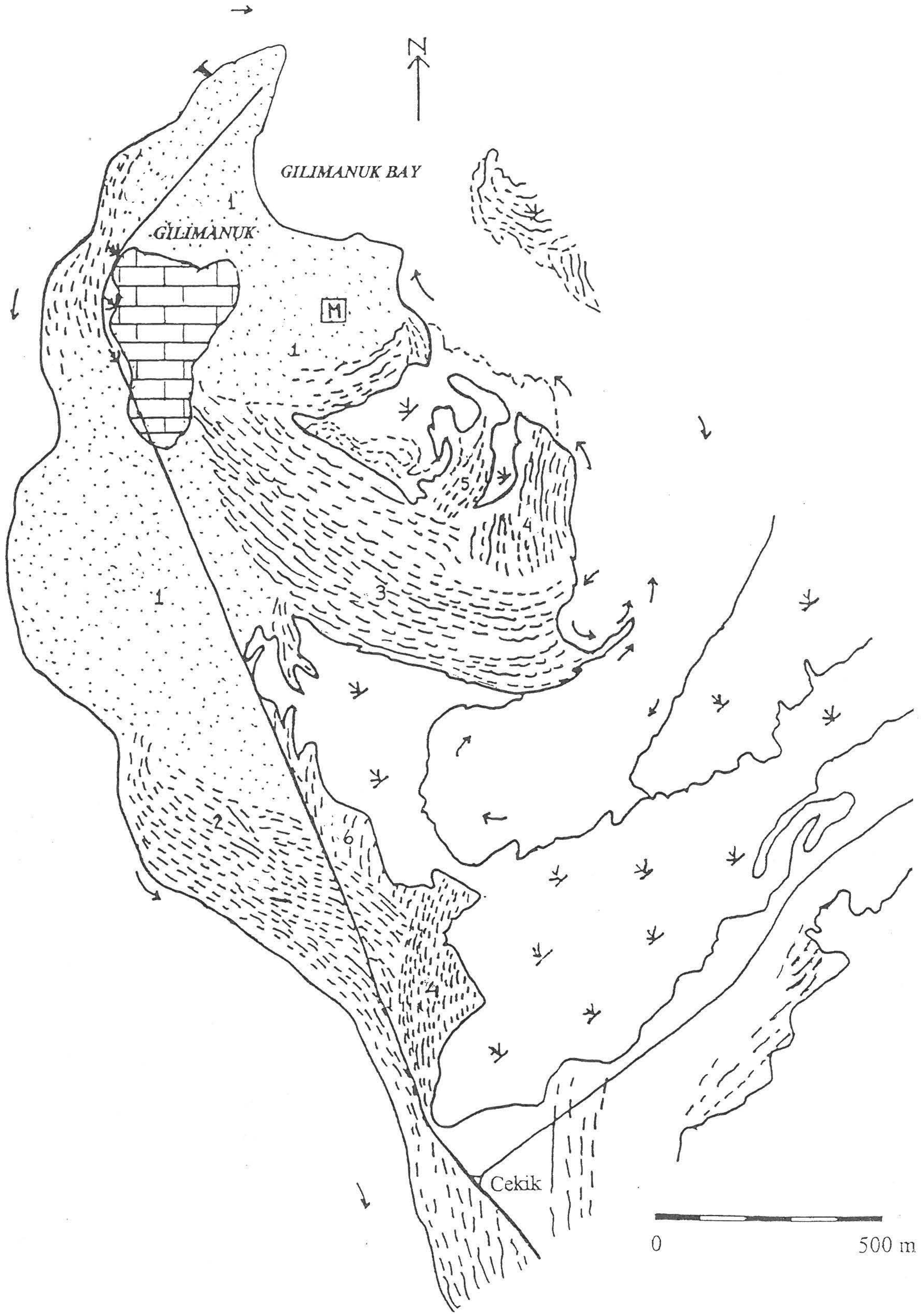


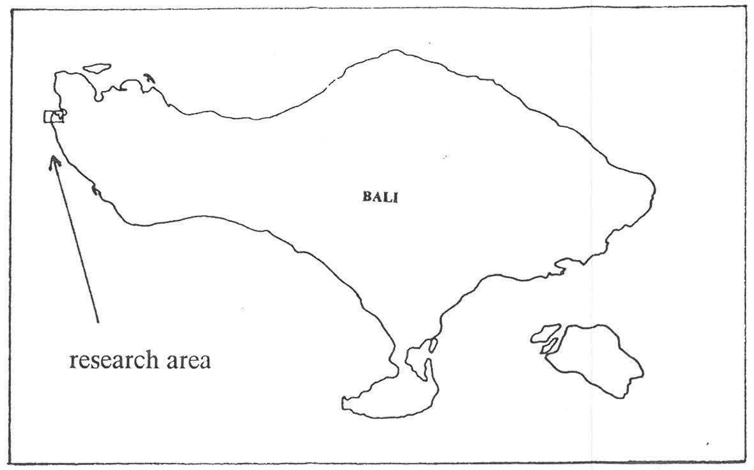
Figure 2.2. Excavation Squares in Zone I, Gilimanuk.
(from Pusat Penelitian Arkeologi Nasional Jakarta 1990, with some modifications)

Sunarto (1993:22-29) used LANDSAT imagery to conclude that Prapat Agung Mountain, the limestone hill of Gilimanuk and the Banyuwedang mountains were all formed during the Pliocene Epoch as part of the Prapat Agung marine limestone formation. Prapat Agung and Banyuwedang were subsequently uplifted, while Gilimanuk sank under the sea and survived as a small limestone island (Sunarto 1993:22-29).

Sunarto (1993:22-9, 31-2; 1998, pers. comm.; see figure 2.3) further proposed that processes of sedimentation resulting from longshore drift formed six sand-spits surrounding Gilimanuk Island and linking to the northwest tip of Bali Island via Cekik. Zones of excavation I and II are situated in sand-spit I, while zones III, IV, and V are in younger sand-spits III, IV and V respectively. Thirty-six of fifty-four squares excavated in zones I and II have clearly yielded indications of burial activities. Six squares dug in the remaining zones, however, only brought forth a number of artefacts without burials. Ramelan (1988:50-1, 68), based on LANDSAT imagery, also suggested that Gilimanuk island was occupied before becoming joint to Bali. But better dating for each sand-spit must be provided to confirm the period of occupation of Gilimanuk and the changing geomorphological relationships between Gilimanuk, Cekik and Bali.

In assessing the possibility of the use of Gilimanuk for occupation as opposed to burial, several factors must be taken into account, particularly the availability of fresh water. Sunarto (1993:40-3, 52) suggested that the site was not ideal due to the saline quality of the ground water, unavailability of clay for making pottery, danger of tsunamis and the possibility of malaria in the mangrove forests. Such suggestions, however, seem not to be fully proven. Samples of water taken from 16 modern wells prove that fresh water is available in the limestone, although water from wells in the sand spits is salty (Ramelan 1988: 57-8). Higham (1996:3) has also suggested: 'The shallow seas and mangrove shores indented with estuaries which characterise the coast of tropical Southeast Asia provide the world's richest habitat in terms of biological activity'. All this suggests that Gilimanuk might have been occupied rather than used simply for burial, and this will further be confirmed with presentation of the results of excavations.





Legend:

- : Gilimanuk hill, part of the Prapatagung Formation
- **1-6** : succesive sand-spit, from the oldest to the youngest
- : mangrove
- **M** : Gilimanuk Museum
- : roads
- : ferry wharf
- : marine notches
- : longshore current

Figure 2.3. The growth of the Gilimanuk complex, showing sand-spits and adjacent areas, based on Interpretation of a Semicontrolled-panchromatic Aerial Photograph 1:10,000 (1970)

(from Sunarto 1993 figure 3.8, with some modification)

Finds from Burial Contexts

Soejono (1977:177-9) stated that some of burial occurred in the third layer at Gilimanuk, but was concentrated in the fourth layer. Complete and incomplete skeletons of more than 240 adults, juveniles and infants (Soejono 1995:182; Soeprijo 1983:512) had been discovered until the latest excavation in 1997. Skeletal analyses carried out by Teuku Jacob (1967 cited in Soejono 1969:10) and Soeprijo (1983:512) showed that the early Gilimanuk inhabitants had Mongoloid racial affinities. Soeprijo (1983:512) added, however, that some Melanesoid characteristics are still retained. The results of these analyses also indicated age, sex and bone anomaly details for some of the skeletons (Soeprijo 1983, 1985). Filed teeth can be recognised on some individuals, mostly on males because many females were destitute of teeth (Soeprijo 1983:513).

Several burial methods were utilised in Gilimanuk, but most burials were primary or secondary without any containers (Soejono 1995:182). Containers used in burial activities in Gilimanuk were two double jars from squares S.I and S.IV, unearthed in the 1963 and 1964 excavations (see Soejono 1977:191, plate151-6), and two stone sarcophagi from square S.L of the 1994 excavation (Yuliati 1994:9; Soejono 1995). The primary burials were either single, double one above the other, or double side by side in opposing positions (Soejono 1979:196). The skeleton could be extended, semi-flexed or crouched (Soejono 1979:196). Secondary burials were suggested by the appearance of few bones (Soejono 1977:187-8) or complete skeletal segments (Soejono 1969:7).

The primary extended single burials were found in squares S.II, S.III, S.X and S.XI (Soejono 1977). Numerous artefacts were found associated with these burials, of which the majority were oriented northeast-southwest, with skulls in the southwest (Soejono 1977:236). In square S.II, skeleton number XI was recovered along with two different sized bronze earrings at left and right of the skull, and a bronze bracelet on the right arm. An iron spearhead was found close to skeleton XI (Soejono 1977, plate 148). Skeleton number XXVII found in layer 4 of square S.X was accompanied by two bronze axes of Soejono type VI placed between the femora, and two net-impressed decorated pottery vessels close to the skull (Soejono

1977, fig. 127, plate 140). Burial gifts for skeleton number XXXV at square S.XI, included an unreported number of bronze axes of Soejono type VI that were found between the femora, a bronze bracelet still around the left arm, and a bronze earring on the right side of the skull. In addition, the skeleton of a dog was buried on the left side of burial XXXV and three net-impressed decorated pottery vessels were found close to its legs (Soejono 1977, fig. 129, plate 143).

In discussing the primary burials, Soejono (1969:7) noted that '...in some occasions bones of the upper and lower extremities were mutilated ...'. Soejono (1977, fig. 128) claimed that the disappearance of the two *tibia* from skeleton VI indicated the practice of mutilation. Found in square S.III, this skeleton was accompanied by a pottery vessel close to its foot (Soejono 1977, fig. 128).

Clearly, most burials were furnished with grave goods of different quality and quantity (see Soejono 1995:182). Unfortunately, each kind of goods were rarely reported with its numbers. The grave goods comprised various shapes and sizes of pottery, metal items, beads and sacrificial animals (pigs, dogs and fowls) (Soejono 1977:175). Bronze items comprised axes, hoes, arm and leg bracelets, earrings, spirals and pentagonal plates (Soejono 1977:182; Soejono 1979:193) in various sizes and shapes. Pentagonal plates, usually found under skulls, were perhaps ornaments (Soejono 1977:17). Some pig, dog and fowl skeletons or bones were found close to human skeletons, so they were suggested also as funeral gifts (Soejono 1977:186). Until the latest excavation in 1997, three pig and seven chicken skeletons had been found, each placed with human burials, but so far only one dog skeleton has been recovered along with a human skeleton.

There was apparently no sex or age differentiation in the amount and variability of grave goods in the site. Age and sexed of fifteen skeletons showed that males, females, adults (25 to 55 years old), infants (0 to 6 years old) and juveniles (12 to 14 years old) (Soeprijo 1983) were all furnished with similar grave goods, such as pottery vessels, glass beads and metal objects. In addition, two or three human skeletons supposed to be family members were found overlying each other in several burial pits (Soejono 1979:196). In these instances, Soejono (1979:196) argued that the deceased were not buried at the same time, and the pits needed to be re-dug for burying the later deceased. If this was the case, there will be difficulties in determining grave goods for each individual, due to past disturbances.

The two double jar burials in Gilimanuk contained bones of secondary burials without any grave goods (Soejono 1977:191-2). However, under one of two jars, which contained 'complete bones of a single person' (Soejono 1969:6), was found a human skeleton in 'prostrate' position, supposed to be a funeral sacrifice (Soejono 1977:191-2). The jar, approximately 40 cm high and 60 cm wide, had net impressed decoration. Apart from the jar burials, two stone sarcophagi have also been found in Gilimanuk. Both sarcophagi, located approximately 30 m to the southwest of the Gilimanuk Museum, had been disturbed before their discovery (Soejono 1995:182). Sarcophagus A, made of limestone, is similar to the Ambiarsari type for the coffin and the Munduk Tumpeng type for the lid (Soejono 1995:182-3). Ambiarsari and Munduk Tumpeng are located approximately 20 km and 37 km to the southeast of Gilimanuk (Soejono 1995:182-3). Sarcophagus B, of volcanic tuff, is included in the Busungbiu type. Busungbiu is located approximately 60 km away to the east of Gilimanuk (Soejono 1995:182). Sarcophagus B was found approximately one meter away from and parallel to sarcophagus A, which was found first by local people (Soejono 1995:182). Both sarcophagi contained small fragments of human bone, teeth and sherds. Near the sarcophagi, but not inside them, were found plain and decorated sherds, an earthenware stove, glass beads and two iron objects (Soejono 1995:183; Yuliati 1994:9-14). Due to the disturbance, explanations about the burial methods and the variety of grave goods in association with the sarcophagi are difficult to formulate.

Pottery

Soegondho (1985:46) states that the intact pottery vessels recovered from burial contexts in Gilimanuk consist of 'jars, dishes, lids, incense burners, plates, and water pitchers in several shapes and sizes'. In addition, distinctive terracotta stoves also appeared in Gilimanuk. An intact terracotta stove and fragments of plain and decorated examples (see figure 2.4) were retrieved from squares S.XXIV,

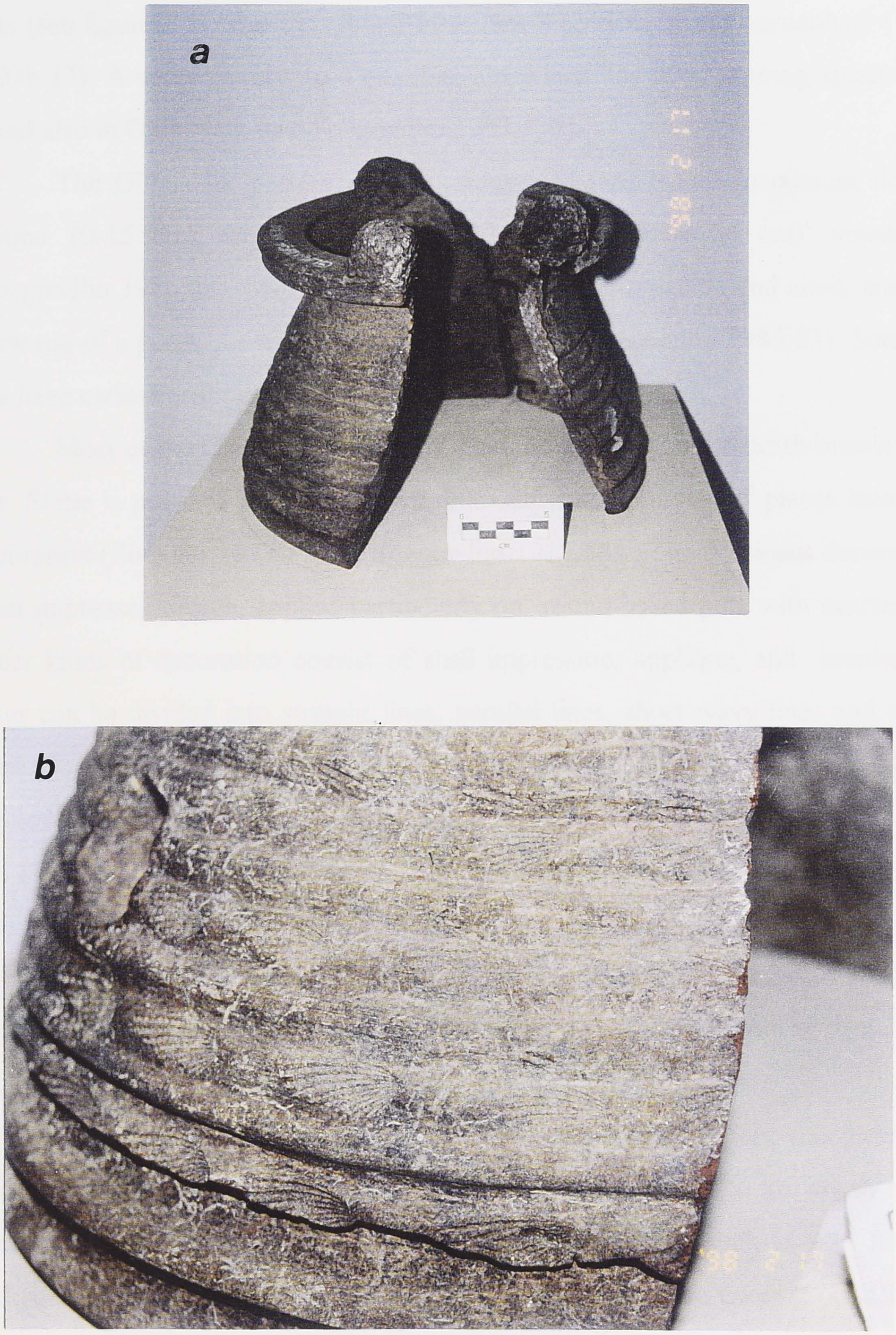


Figure 2.4. A terracotta stove from Gilimanuk (a);
detail of bivalve shell impressions (b).

S.L, S.LIV, and S.LV in spits 4 and 5 (see Indraningsih 1977; Yuliati 1994, 1996), while a pottery stand known as a *lekeh* in Balinese today, usually used for supporting pots (see figure 2.5), was also found in square S.L, close to the sarcophagi (Yuliati 1997b:13). A vessel similar to a crucible, but which has two "pouring spouts", was found also in Gilimanuk (see Soegondho 1993:437).

The Gilimanuk pottery can be categorised into 'small (maximum diameter around 10-15 cm); medium (16-30 cm); and large (over 31 cm)' vessel sizes (Soegondho 1985:48). Most pots were made by using a paddle and anvil, and some show use of a potter's wheel (Soejono 1977:180-1, Soegondho 1985:53). Some vessels have carinations, pedestals or corrugations.

Most of the Gilimanuk pottery is plain, grey-brown and reddish brown in colour. Some is polished and red slipped, but only small number of pieces have other decoration (Soejono 1977:180-1; Soegondho 1985:48). The dominant decoration is a net impressed design, applied particularly on round-based pots with everted rims. Other kinds of decoration consist of shell impression, applique, and incision. The latter can be divided into straight lines, parallel lines, short wavy lines and crossed lines (Soejono 1977:180; Soegondho 1985:48). A net impressed pattern was also applied to fragments of stoves from square S.XXIV (Indraningsih 1977) and square S.L (Yuliati 1994). The latter stove also had shell impressed decoration (see figure 2.4). Together with that stove, a burnished pottery vessel with an incised human face was deposited close to the two sarcophagi in square S.L (Soejono 1995:183). Such pottery has never been reported before in Gilimanuk and now is stored in the Museum Purbakala Gilimanuk (see figure 2.6).

Soejono (1977:272-3) proposed that the Gilimanuk pottery was identical to that from Cekik, and probably it was also produced at Cekik, 6 km south of Gilimanuk. The reasons were that evidence for pottery making, such as sites for firing and sherd dumping places, were not found in the Gilimanuk excavations (Soejono 1977:272-3), and neither was any pottery making equipment (Ramelan 1988:93). The results of chemical analysis and geomorphological observation also support that proposition. Sunarto (1993:51-2) reports that clay sources for making pottery are available at the beach of Cekik-Tirta Empul Ulu. However, comparison of the

Figure 2.5. A pot stand from Gilimanuk.

Figure 2.6. Fragments of a pottery vessel from Gilimanuk, with an incised human face.
(Courtesy: National Research Centre of Archaeology, Bali Branch)

chemical components of pottery from both Cekik and Gilimanuk still needs to be done. Another alternative is that Gilimanuk inhabitants might have just taken the raw materials from the Cekik-Tirta Empul Ulu region and then produced the pottery in Gilimanuk.

Concerning the problem of pottery sources, more analysis of potsherds should be done to provide alternative solutions. A complement to Soegondho's (1993) analysis, another sample of twenty-three sherds from Gilimanuk has been utilised in this research. The results of a scanning electron microscope (SEM) analysis of these sherds, are presented in an appendix.

Beads and Bracelets

Many beads were recovered, from the top to the basal layers, and abundantly within both settlement and burial contexts (Indraningsih 1985:136). Dominated by glass beads, the others are made of shell, stone, gold (Indraningsih 1985:137) and baked clay (Soegondho 1995:19). The monochrome glass beads are blue, red, yellow, orange, green, white and black in colour (Indraningsih 1985:137). Opaque brownish red glass beads known as *mutisalah* also occur (Soegondho 1995:19).

Indraningsih (1985:137) stated that the Gilimanuk beads have 'globular, oblate, barrel-shaped, cylindrical, ellipsoid, annular, hexagonal prismatic, collared, rectangular faceted, and lozenge' shapes. Decoration can be seen on some beads, such as white lines or linear patterns on black beads, and floral motifs on golden beads (Indraningsih 1985:137). The appearance of glass bead scrap in this site has been assumed to indicate bead production (Indraningsih 1985:138).

Besides bronze bracelets, mainly found in burial contexts, shell, glass (Soejono 1977:184) and terracotta bracelets (Aziz 1983:34) were also found with. The glass bracelets, 7 to 8 cm in diameter, approximately 1 cm thick, have concave-convex, hexagonal, or ellipsoid cross sections (Soejono 1977:184). Their colours are green, blue and brown (Soejono 1977:184), and one of the brown glass bracelets has a triangular cross section. Bracelets of Strombus, Pleurotomariidae, and Tridacna shell have ellipsoid or thin rectangular cross sections (Soejono 1977:184), while terracotta bracelets have rectangular or circular cross sections less than 1 cm thick. Two small terracotta bracelets, one plain and one with dot-impressed decoration, were found in association with a secondary burial (CXXXVI) in square S.LVIII spit 13 (Yuliati 1997a:13-6). These were recovered along with other grave goods: 63 glass beads, two pottery vessels, skeletal remains of an animal, possibly a pig, and fragments of a blue glass bowl (Yuliati 1997a:13-6). Glass bowls are so far uncommon in Early Metal Phase sites.

Finds from Non-Burial Contexts

In contrast to finds in secure burial contexts, a number of other finds, such as bronze fishhooks and axe fragments (Soejono 1977:182), have received much less attention. In this regard, Soejono (1977:182; 1979:193) argued that they had possibly been discarded or dropped, and unfortunately, the original positions and context of such finds have not been reported (see Soejono 1977:182). Consequently, their relationship with other finds from non-burial contexts will be difficult to be ascertain, making it difficult to find clear evidence for habitation use of the site.

Soejono (1977:185, plate 170) also reported that small pounding stones showing abrasions and small mortars with circular shallow holes were found in non-burial contexts. Those stones, together with shell tools, were grouped as domestic tools (Soejono 1977:185). Soejono (1979:194) stated that the shell tools comprise 'points, borers, scrapers, knives, and spoons...'. He added that 'scrapers and points are often made of the ventral margins of bivalve shells [while] ...spoons and shallow cups are made of the concave walls of big cowry shells' (Soejono 1979:194). Besides big cowries, small cowry shells also appeared in presumed habitation deposits (Soejono 1979:195). The appearance of cowry shells in Gilimanuk is interesting, as cowry shells were widely used as currency (see Dalton 1975:97). Unfortunately, there is no information about any treatment of the shells, such holes for putting them on strings. Pierced shell pendants and a perforated incisor of a dog were also retrieved from the presumed habitation layer, together with a fragment of a terracotta bird-like statuette and 'a pedunculate stamp of baked clay bearing impressed net design on the circular surface' (Soejono 1979:195).

A number of lithic items were deposited in spit 15 of square S.XXVII. They consist of a number of obsidian flakes, and flakes of chert, agate, andesite and limestone. They occurred with one bone tool, animal bones and potsherds. In addition, obsidian flakes were recovered in spit 5, square S.XXIII in the 1977 excavation (Indraningsih 1977:28). The appearance of imported lithic materials in Gilimanuk is interesting, but so far there has been no investigation of sources or functions.

Besides these finds, ceramic sherds and a Chinese coin were also found in Gilimanuk. The ceramic sherds were recovered in squares S.XXVII and S.XXX from unreported depth, in square S.XXII spit 5 (layer 3), and in square S.XXII spit 5 (layer 3). The Chinese coin was found in square S.XXIII spit 3 (layer 2). The position of these finds up to about 55 cm depth makes it necessary to consider whether they are a result of disturbance.

Despite the fact that the third layer of the Gilimanuk stratigraphy has been claimed as an occupation layer by Soejono (1977:178), the location of any settlement area has not been yet clearly determined. A test pit excavated 50 m west of the area of excavations in zones I and II seemingly showed that the density of sherds and shell decreased in this location (Soejono 1977: 177). As a result, Soejono (1977:177) assumed that the settlement was spread more to the southwest of Gilimanuk Bay. This assumption clearly needs to be tested by excavating the areas indicated.

In addition, six squares excavated in zones III, IV and V yielded artefacts. The layers here were reported as stratigraphically similar to those in zones I and II, but without burial contexts (see Tim Ekskavasi Gilimanuk 1979). Five iron items were found in spit 11 of rescue excavation in zone III. Square S.XXX, spits 3 to 17, in zone IV yielded a number of bronze bracelets, fishhooks, small axes and some unidentified metal fragments. Square S.XXXI in zone V yielded a fragment of a small bronze axe and another small bronze fragment in spit 4, with a fragment of an iron tool, possibly a dagger, and an iron chisel in spit 6. Pottery vessels, sherds and bones were found in spits 5 to 8 of square S.XXXI (Tim Ekskavasi Gilimanuk 1979).

Three other squares, that is squares S.XXIX and S.XXXII in zone III, and S.XXXVII in zone IV, however, were reported have no finds at all, except for some sherds and shells in square S.XXXII spits 3 to 6 (Tim Ekskavasi Gilimanuk 1979; Balai Arkeologi Denpasar 1986). A more careful investigation is required to confirm whether the occurrence of artefacts in these zones is a consequence of habitation, or merely the sedimentation processes which formed sand-spits III, IV and V.

Faunal remains outside burial contexts include shells, and bones of fish, rats and bats (Soejono 1977:185-6). While only a small number of fish bones were recovered the in excavations (Aziz 1983:37-8), large numbers of shells were found, some suggested to be food debris (Soejono 1977:185-6), others the result of natural sedimentation processes (Sunarto 1993). Some bones and shells from the top and third layers showed indications of having been burnt. As well, a fragment of a bovid mandible was found in square S.XXVII spit 15, together with pieces of stones, but their relationships are uncertain. It should be noted that a number of pig skeletons were also recovered in the upper layer, and Aziz (1983:41) has suggested that they were recently buried.

Dating

Nine samples of charcoal were collected from different depths within three squares, that is S.XX, S.XXI, and S.XXII. The dates for the samples provided by the Laboratorium voor Algemene Natuurkunde in Groningen (Soejono 1977:280-1, 350), are listed below.

Table 2.1. C14 dates for samples of charcoal from Gilimanuk
(from Soejono 1977:280-1, 350)

Sample Code	Sample Origin	C14 Dating
Gilimanuk I (GrN-7125)	(layer c)	1725 ± 80 BP
Gilimanuk II (GrN-7126)	Square S.XX, 50-60 cm depth	1650 ± 55 BP
Gilimanuk III (GrN-7127)	(layer c)	1940 ± 115 BP
Gilimanuk IV (GrN-7128)	Square S.XXI, 150 cm depth	1850 ± 55 BP
Gilimanuk V (GrN-7129)	(layer c)	2020 ± 165 BP
Gilimanuk VI (GrN-7130)	(layer c)	2000 ± 70 BP
Gilimanuk VII (GrN-7131)	(layer c)	1965 ± 50 BP
Gilimanuk VIII (GrN-7132)	Square S.XXII, 150 cm depth	1800 ± 85 BP
Gilimanuk IX (GrN-7133)	(layer c)	1890 ± 100 BP

Mook (cited in Soejono 1977:350), who reported these results noted that gave a 'Standard deviations exceeding 55 years are large due to an insufficient amount of sample'. Based on a selected sample of dates, i.e. Gilimanuk II, IV and VIII, Soejono (1977:280-1) suggested that the time span of human occupation at Gilimanuk was about 200 years. The one-sigma calibration (University of Washington C14 Calibration Program 1993, Rev.3.0) for the dates from precise locations, i.e. samples II, IV and VIII, are AD 348 (420) 443, AD 89 (150, 190) 242 and AD 126 (240) 371 respectively.

Aziz and Faisal (1997:56-7) provide more dates for Gilimanuk from bones of three human skeletons recovered from a rescue-excavation (S.PNY II) and one skeleton from square S.XLIX. In square S.PNY II, skeleton number 131 was placed beneath 129 (Aziz and Faisal 1997:57). The samples have been analysed by the Nuclear Research Centre Yogyakarta, BATAN (Aziz and Faisal 1997:57-8), and the results are as follows.

Table 2.2. C14 dates for samples of human bone from Gilimanuk.
(from Aziz and Faisal 1997:57-8).

Sample Code	Sample Origin	Estimation of age at death	C14 Dating
129 a	S.PNY II, 125-150 cm depth (layer c)	> 10	1403 ± 83 BP
129 b	S.PNY II, 125-150 cm depth (layer c)	10 - 15	1215 ± 61 BP
131	S.PNY II,125-150 cm depth (layer c)	10	2320 ± 146 BP
132	S. XLIX, 155 cm depth (layer c)	± 15	1274 ± 57 BP

Aziz and Faisal (1997:57) argued that these dates reveal that the Gilimanuk burial activities took placed across a wide area, and a series of burial activities had been carried out in one pit (i.e. in S.PNY II) over a long period. Aziz (1996:125) claimed that the incomplete bones of the three skeletons in S. PNY II support the argument that the burial pit was reused. I find that this suggestion needs to be revised based on calibrated dates.

Aziz (1996:120) has also provided dates for mollusc shells and coelenterate from burial the contexts in square S.PNY II, which is located in zone I. These samples were analysed by the Nuclear Research Centre Yogyakarta, BATAN, and dated to 2583.95 ± 54.93 BP (BATAN) and 2398.99 ± 55.51 BP (BATAN) (Aziz 1996:120). However, these need marine reservoir subtraction of 450 years before calibration. Aziz (1996:120, 124-5) claims that these dates indicate that the earliest burial activity took place soon after the initial formation of sand-spit I. So, she argued that an occupational area might not have been present in this locality (Aziz 1996:124-5).

In relation to all these dating samples, some crucial problems appear and should be discussed. Firstly, if the shell date is meant to date the process of initial sedimentation of sand-spit I, the date seems to be unreliable as it is very close to that of the burial activities. Moreover, Soejono's (1977:280) samples of charcoal for dating the occupation layer were extracted from layer c, the same layer in squares S.XX, S.XXI, and S.XXII as in S. PNY II. They date back to the same period. The squares of Soejono's excavation were also located in sand-spit I. So, I suggest that the use of Gilimanuk, for both burial and occupation, took place after the land became stable. This means that the formation of sand-spit I (see Aziz 1996:120) is quite possibly much older than the date proposed.

Secondly, the bone dates trapped Aziz and Faisal (1997:57) into concluding that the burial pit was used more than once with a remarkable time gap. However, these samples could have been contaminated, so that such a conclusion should be tested by using other samples. It should also be noticed that human bones are often poor materials for C14 (Child et al. 1993; Bellwood 1998 pers. comm.). Considering the position of the three skeletons together at 125 - 150 cm depth, it is quite possible that the burial events occurred at almost the same time, and that at least one of the bone dates is wrong.

The Metal Objects

The previous description indicated that metal objects from Gilimanuk are mostly found associated with human skeletons as funeral gifts, and only small numbers were found apart from burial contexts. Rarely found well preserved, bronze items are the most frequent finds unearthed, followed by a number of iron objects. Artefacts of gold-like metal were only rarely found.

Axes are the most numerous bronze items recovered from Gilimanuk. Aziz (1983:113-4) stated that the axes and hoes from the 1963, 1964 and 1973 excavations can be classified into Soejono types IV-B, V-A, V-B and VI. While Soejono types IV-B, V-B and VI were not found in the 1977 and 1979 excavations, Aziz (1983:115-6) has since reported sub-types and variants of type V-B. Aziz (1983:115-6) claimed that sub-type V-B1 has two variants, V-B1-a and V-B1-b, and sub-type V-B2 has one variant, V-B2-a. The blade of sub-type V-B1 is described as rectangular and thin, while the wings of the sockets are long and thin (Aziz 1983:120; see figure 2.7). Aziz (1983:123) further claimed that, unlike the former, sub-type V-B2 seemingly does not have a separate blade, or the blade might be unified with the body of the tool forming a rounded tip.

The chemical components of some of the Gilimanuk bronze objects have been analysed by Aziz and Sudarti (1996) and Aziz and Priyono (1997). Six thin pentagonal plates recovered from under the skull of skeleton number CXXIX (dated to 1215 $\pm$ 61 BP), from square S.PNY II, were analysed by X-ray fluorescence spectrometry and cross-checked by complexometry (Aziz and Sudarti 1996:3-5). The pentagonal plates were assumed to have been produced by casting and cold annealing (Aziz and Sudarti 1996:5). Aziz and Sudarti (1996:6) suggested that microstructure analysis indicates that the thin pentagonal plates were attached together using hematite. However, the exact reasons why they were attached have not yet been explained. Aziz and Sudarti (1996:6) also claimed that the metal for the pentagonal plates came from recycled bronzes.

Microstructure analysis was also done by Aziz and Priyono (1997) on some other bronze objects: (1) a left earring of skeleton number XXXVIII from square S.VIII; (2) a blade of a small axe from spit (4) square S.XIII that was associated with skeleton LII; (3) a large axe from square S.XXI (B-6); (4) a solid bracelet from spit 11 (125 cm depth) square S.XXIV; (5) a hollow bracelet from square S.XII. The chemical compositions of these fragments, including the pentagonal plates, can be

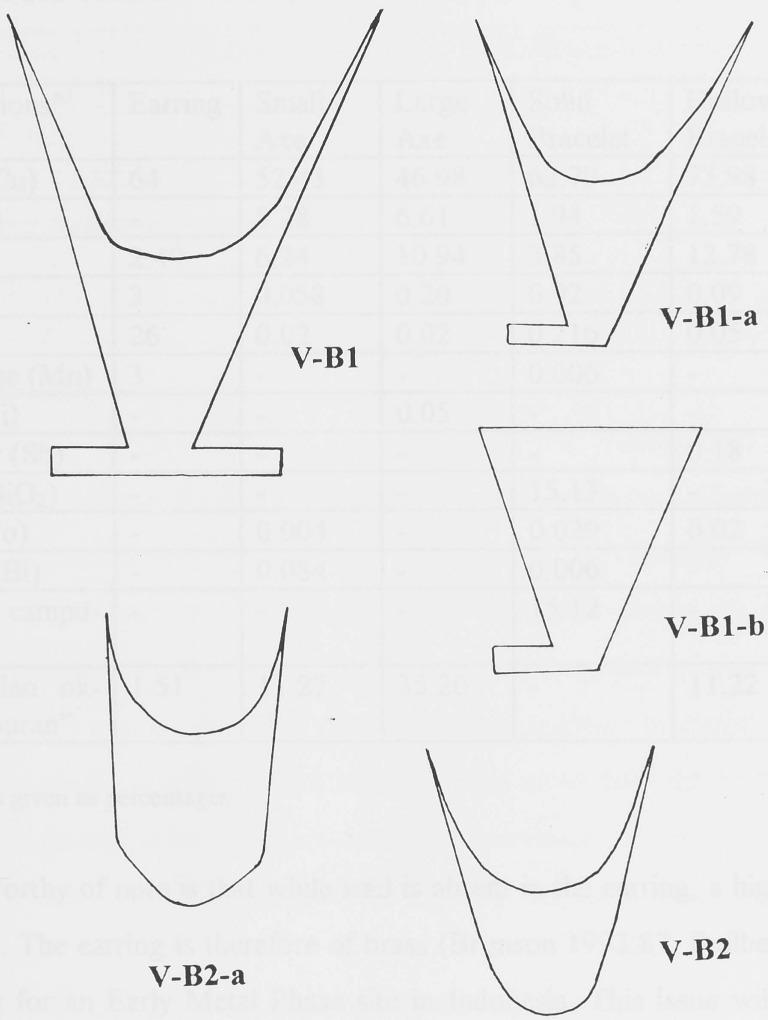


Figure 2.7. Variants of the Soejono type V socketed axes, proposed by Aziz (1983) (from Aziz 1983:120-4)

seen in table 2.3.

Table 2.3. Chemical compositions of some Gilimanuk bronze objects.
(from Aziz and Sudarti 1996:3-5; Aziz and Priyono 1997:10-12)

Compositions*)	Earring	Small Axe	Large Axe	Solid Bracelet	Hollow Bracelet	Pentagonal Plate
Copper (Cu)	64	52.43	46.98	62.79	73.98	54.70
Lead (Pb)	-	8.28	6.61	1.94	1.59	6.20
Tin (Sn)	2.49	6.24	10.94	3.85	12.78	11.37
Iron (Fe)	3	0.058	0.20	0.92	0.09	0.02
Zinc (Zn)	26	0.02	0.02	0.216	0.05	0.01
Manganese (Mn)	3	-	-	0.006	-	?
Nickel (Ni)	-	-	0.05	-	-	0.04
Antimony (Sb)	-	-	-	-	0.18	-
Silicate (SiO_2)	-	-	-	15.13	-	9.45
Cobalt (Co)	-	0.004	-	0.029	0.02	-
Bismuth (Bi)	-	0.084	-	0.006	-	-
"Oksida campuran"	-	-	-	15.12	-	
"Silikat dan oksida campuran"	1.51	11.27	35.20	-	11.22	-

*) all values given as percentages

Worthy of note is that while lead is absent in the earring, a high level of zinc is present. The earring is therefore of brass (Bronson 1992:87; Bullbeck pers.com.), surprising for an Early Metal Phase site in Indonesia. This issue will be discussed later in Chapter 4.

Aziz and Priyono's (1997) results for the large axe are rather different from the results of previous chemical analysis on two Gilimanuk bronze axes provided by Soejono (1977:23, table 1, based on Direktorat Geologi 1973). Total percentages of the compositions are not mentioned, as well as the reasons for missing values (see table 2.4).

Aziz and Priyono (1997:10-12) claimed that casting techniques using sandy-clay moulds were used on all the fragments analysed, while the fragment of a hollow bracelet also indicated cold bending and annealing at 310° Celsius. Aziz and Sudarti (1996:5) and Aziz and Priyono (1997:10-12) stated that annealing was applied to the

Table 2.4. Chemical composition of Gilimanuk bronze axes.
(from Soejono 1977:23, table 1)

Compositions*)	Gilimanuk Bronze Axe 1	Gilimanuk Bronze Axe 2
Copper (Cu)	35.41	34.56
Lead (Pb)	4.41	6.34
Tin (Sn)	6.92	14.92
Iron (Fe)	0.73	1.25
Aluminium (Al)	2.32	3.37
Silicate (SiO_2)	16.15	9.65

*) all values given as percentages

pentagonal plates and the hollow bracelet, but not to the axes. Questions arise here as to whether annealing was a later development of Balinese metallurgy, or whether a thin sharp and annealed blade was not necessary if the axes were produced for non-practical purposes, for instance as grave goods. To answer this question, more analysis of other axes from clear contexts is urgent. Besides, while casting moulds for producing such artefacts have never been found in Bali, the temperature suggested above seems too low for annealing (i.e. hardening of metal objects by heating, and hammering). Consequently, such assumptions need to be discussed later.

In contrast to the bronze objects, iron specimens from Gilimanuk are rare. They were recovered from layers 1 to 3 in nineteen squares, along with bronze and gold objects, in or outside burial contexts. Mainly found in layer 3, the iron specimens consist of two iron daggers and three spearheads in association with burials, some pieces of iron slag, and unidentified specimens (Soejono 1977:182; Soejono 1979:193). It is important to note that one of the two daggers has a bronze handle, while remains of a wooden scabbard and a rough textile survive on the shafts of both artefacts (Soejono 1977:182; Soejono 1979:193).

Gold-like metal objects, consisting of beads, small cone-shape objects and eye and mouth coverings were discovered in association with burials in layers 3 and 4 in six squares. One gold ring was unconnected with a burial (Soejono 1979:193), and neither were two gold beads and one ornament.

PLAWANGAN

The Plawangan site, approximately 500 meters inland from the coast and 4 meters above sea level, is situated in Kragan district, Rembang, north coast of Central Java. The site formerly covered only Plawangan village (Sukendar and Awe 1981:4), but later survey and excavations indicated that it stretches into Balongmulyo village, 3 km to the east of Plawangan village (Tim Penelitian Plawangan 1989; Prasetyo 1994/5:3). This site was discovered accidentally by the local inhabitants in 1977 (Sukendar and Awe 1981:4), and has been disturbed by recent activities. A number of finds associated with a jar burial (Sukendar and Awe 1981:8) attracted much public attention, and since 1977 a series of surveys and excavations has been undertaken (Prasetyo 1994/5:10).

According to Sukendar and Awe (1981:12; see also Bintarti 1980; Tim Penelitian Plawangan 1981, 1983, 1989, 1992) the average depth of the excavation squares was about 150. There are four stratigraphic layers that were not clearly reported, but burial activities can be recognised in layers 3 and 4 (see Sukendar and Awe 1981). These layers overlaid volcanic facies that do not have any cultural deposit (Djubiantono 1990). The four layers of the Plawangan site that can be described in general as:

a. A black-grey sandy humus, approximately 20 cm thick.

b. A yellow-grey sandy soil, 25 cm in average thickness, containing a small number of sherds and shells.

c. A brown sandy soil, 35 cm in average thickness, containing numerous sherds, shells and burials in some squares.

d. A grey sand, about 15 cm to 65 cm thick, containing a small number of sherds and shells, and jar burials in some squares.

Shells and sherds were reported as appearing in most layers, tending to increase in the third layer, and decreasing in the lowest layer (see Bintarti 1980; Tim Penelitian Plawangan 1981-92).

Up to 1993, fifty-eight squares had been excavated in Plawangan, but in different sizes: 3 meters by 3 meters, 3 meters by 1.5 meters, while generally were 1.5 meters by 1.5 meters (see Sukendar and Due Awe 1981:8; Tim Penelitian Plawangan 1980-92). The site covered an area of more than 2000 square meters (Prasetyo 1994/5:10). Sukendar and Awe (1981:25) and Prasetyo (1994/5:21) claimed that the excavations revealed indications of burial activities, such as skeletons in certain positions accompanied by funeral gifts, and evidence of settlement. However, Prasetyo's (1994/5:21) suggestion that sherds, net sinkers and Chinese coins provide supporting evidence for the existence of a settlement is not appropriate. This is because there is no attempt in his report to separate the finds chronologically or by context. Such claimed evidence for settlement would certainly be better if it came from a good stratigraphical context.

The dating for this site is also uncertain. Samples of charcoal analysed by BATAN are claimed to range between 1500 BC and AD 400 (Soegondho 1995:27). A sample of human bone collected from the 1978 excavation has been dated to 302 ± 73 BP (UGA-S1) (Boedhisampurno and de Filippis 1991:3). The broad range of the Soegondho's date makes it difficult to state anything useful about the date of the appearance of iron working in Indonesia. The bone date calibrates (University of Washington C14 Calibration Program 1993, Rev.3.0) to AD 1484 (1640) 1663, and is quite possibly not related to the prehistoric sequence. Unfortunately, there is no published information about the context of the bone which can be used to check the reliability of the date.

Finds from Burial and Non-burial Contexts

Evidence for burial activities at Plawangan comprises forty-two remains of children and adults, male and female, found from spit 4 to 16 (40 cm to 165 cm depth) (Prasetyo 1987:31; 1994/5:16-7) or layer c to layer d. Burials are in containers or unenclosed inhumations. They can be primary or secondary, some consist of more than one individual (Sukendar and Awe 1981; Prasetyo 1994/5:17; 1987:31; Aziz 1990:160). The single primary inhumations were generally in extended positions, while a few were in semi-flexed or squatting positions (see Aziz 1990:161;

Prasetyo 1994/5:17, 52). Four skeletons discovered in the test pits TP.XVIII and TP.XX were piled up together; skeleton numbers XXIV and XXV were under skeleton numbers XXI and XXII (Boedhisampurno 1990:144). Boedhisampurno (1990) proposed that the inhabitants of Plawangan showed Mongoloid racial affinities with some Australomelanesoid characters. As in Gilimanuk, some filed teeth were also apparent.

Most of the extended burials were oriented southeast-northwest or northwest- southeast. Five skeletons were oriented northeast-southwest, and seven were oriented north-south as with the Islamic burial method. Several orientations could not be reconstructed (see Aziz 1990:161; Prasetyo 1994/5:17, 23). Overlapping burials with different orientations also occurred (Tim Penelitian Plawangan 1981:9, 12; Prasetyo 1994/5:23). In addition, some incomplete skeletons were also found. Bintarti (1980:12) proposed that certain bones were removed deliberately. Comparing the date with Gilimanuk, Bintarti (1980:12) further suggested that the removal of bones in Plawangan might also indicate re-use of burial pits.

Some burials were clearly furnished with complete pots placed above or between the legs, and other grave goods (Sukendar and Awe 1981:20-1; Prasetyo 1994/5:19, 52). Skeleton number I, for example, is a primary burial of an adult provided with two dog jaws placed between the clavicle and scapula, a small iron knife under the two hands which were placed together, and four pots, i.e. a plain cooking pot and three open bowls, placed on the legs (Sukendar and Awe 1981:20; see figure 2.8). Found in spits 6 and 7 of excavation units E-G/4-5 in square I, this skeleton was laid southeast-northwest, and all bones were recovered except for the feet and the right arm (Sukendar and Awe 1981:20). In addition, a large pottery vessel was found next to the skull. There was a small iron knife under its sherds, and a river pebble (9.5 cm long, 1.5 cm wide, 0.9 cm thick) between the sherds and the ribs (Sukendar and Awe 1981:20).

A primary burial (number IV) with the same orientation as burial I, was recovered in spits 9 and 10 of excavation units A-D/1-3 in square I (Sukendar and Awe 1981:20). A small pottery vessel with a lid was placed close to the skull, a pounding stone lay to the right of the shoulder, and three glass beads were found around the

Figure 2.8. Skeleton number I from Plawangan, with grave goods.
(Courtesy: National Research Centre of Archaeology, Jakarta)

neck (Sukendar and Awe 1981:20-1). A small iron knife was also found close to the right arm (Sukendar and Awe 1981:21).

Five round based jars and a bronze kettledrum were used as containers for primary and secondary burials (Sukendar and Awe 1981: 21-2; Yulianto 1990:47). A primary burial, number XIII, in flexed position with 512 glass beads, animal bones, iron tools and sherds, was found inside a cylindrical jar in spits 8 and 9 in square II (Sukendar and Awe 1981:21-2; see figure 2.9). This jar, 80 cm high and 59 cm diameter with a slightly flattered bottom, was covered with two round bottomed jars placed upside down (Sukendar and Awe 1981:22; Aziz 1994/5:2; Soegondho 1995:26-7). Those jars have punched holes around their rims and crossed lines incised on the lips (Soegondho 1995:26-7; Aziz 1994/5:2-3).

A double jar burial similar to that found at Gilimanuk appeared in spit 6 of excavation units C-D/4-5 in square II. This consisted of two round bottomed jars each 26 cm high, placed mouth to mouth alter previously cutting out the rims and the necks. The diameter of the lid vessel is 34 cm while the container is 36 cm (Sukendar and Awe 1981:22). A secondary burial of an adult (number XII) was found inside the double jar, accompanied by 57 glass beads, and two pottery vessels (Sukendar and Awe 1981:22; Aziz 1994/5:3).

A secondary burial (number III) was recovered from spit 8 of excavation units D-G/4-7 in square I, together with skeletal fragments of bovids and fish, teeth of rodents and pigs ("babi hutan") (Sukendar & Awe 1981:20). Fragments of a jar were found surrounding the burial, so perhaps it was originally a jar burial (Sukendar & Awe 1981:20-1). An unidentified iron fragment was also found in this spit, but has no clear relation with the burial. Another secondary burial (number II) was found from spit 7 of excavation units A-D/4-7 in square I, along with crocodile canines and teeth of pig, dog and shark (Sukendar and Awe 1981:25) that might also be grave goods.

The bronze kettledrum, found in spit 12 in test pits XVI and XVIII (Prasetyo 1987:12), was placed upside-down as the container for skeleton number XXVIII, a child. A set of gold foil eye and mouth covers, as well as an iron spearhead, another iron object, a bronze bracelet, pottery vessels, glass beads and a rounded stone were

Figure 2.9. A burial jar from Plawangan, with two lids.
(Courtesy: National Research Centre of Archaeology, Jakarta)

also reported found inside the kettledrum as funeral gifts (Prasetyo 1994/5:19, 39). Another skeleton of a child, number XXVII, was found extended under the kettle-drum, and the intact skeleton of a fowl was placed on its chest (Awe 1990:87). The existence of a skeleton under the kettledrum is interesting. This might be comparable to similar evidence from Gilimanuk, where a skeleton found under a double jar burial has been suggested as a funeral sacrifice (see Soejono 1977, plate 153).

The Plawangan pottery can be divided into containers, such as cooking pots, dishes, bowls, flasks and jars, and non-containers including pot covers, net sinkers, figurines, small terracotta discs (*gacuk*) and remains of baked clay (see Sofion and Diniasti 1990:2). Interestingly, as with the double jar burial, two jars found in square I were placed mouth to mouth alter their rims had been removed (Sukendar and Awe 1981:22). The dimensions of one jar are 40 cm diameter, 24 cm high and 10.45 thick, but the other was too damaged to be measured (Sukendar and Awe 1981:22). The function of this double jar is still difficult to resolve, as nothing was found in it, or bones have probably dissolved. Fragments of figurines in animal, human or other shape, fragments of a terracotta stove (Tim Penelitian Plawangan 1981:3; 1983:8) and *gacuk* were also discovered in Plawangan. The *gacuk* is approximately 40 mm in diameter and 4 mm thick. Unfortunately, there is no information about their context.

Compared to the Gilimanuk pottery, the Plawangan pottery showed some differences in shape and decoration. Some Plawangan pottery was polished and slipped red pottery. Both plain and decorated vessels sometimes have carinations and indications of the use of both paddle-anvil and a slow wheel (Prasetyo 1994/5:13). The former technique was practised for making burial jars, while the latter was applied especially for producing smaller vessels (Prasetyo 1994/5:13). Soegondho (1993) noted that quartzite sand and unidentified plant remains were used as temper. Clay and sand both occur near Plawangan (Tim Penelitian Plawangan 1989:29; Prasetyo 1994/5:4-5).

The Plawangan pottery has incised, impressed, appliqué and painted decoration (Soegondho 1993). In addition, gouging and stabbing techniques were also applied in making triangle and circle designs. The other designs consisted of: dented stamps; straight, wavy or cross-hetched line incisions; braid, dot and shell impressions (see figure 2.10; see also Sukendar and Awe 1982; Tim Penelitian Plawangan 1983:23). Except by Soegondho (1983:130), the net impressed designs which were dominant in Gilimanuk are never reported from this site.

Beads from Plawangan were recovered in the vicinity of skeletons and inside jar burials (Sukendar and Awe 1981:24). Made of shell, stone and glass, their shapes include 'globular, oblate, barrel-shaped, cylindrical, ellipsoid, annular, hexagonal prismatic, collared, rectangular faceted, and lozenge-shaped'(Indraningsih 1985:137). The colours of the glass monochromes are 'blue, red, yellow, orange, green, white, and black' (Indraningsih 1985:137). The biggest bead is about 2 cm long. In addition, a number of terracotta beads also occurred in this site. Among the stone beads, some ellipsoid-shaped black stone beads have acid-etched design in white (Indraningsih 1985:137), similar to ones found in Talaud (see Bellwood 1978, colour picture). Another black and white ellipsoid-shaped stone bead is also comparable to a banded agate bead from the Early Metal Period of the Talaud Islands (see Bellwood 1978, colour picture).

As in Gilimanuk, bracelets made of bronze and shell also appeared in Plawangan, but the numbers are small (Sukendar and Awe 1981:30). Prasetyo (1987:15) stated that a fragment of a bracelet made of brass was also recovered. This last item is quite possibly more recent than the others. A number of terracotta objects of cylindrical, circular or oval shape with a hole in the middle were also uncovered in the Plawangan site. The cylindrical and oval ones are suggested to be net sinkers, while the circular ones are assumed to be beads. This claim needs to be examined further, as these artefacts are too big to be used as beads, and there are similarities with spindle whorls for weaving (see Archaeology Division 1991:195).

The animal remains from Plawangan, found in burial and non burial contexts, are more varied than those from Gilimanuk. Besides shells of molluscs there are bones of pig (*Sus scrofa*), dog (*Canis familiaris*), cattle (probably *Bos banteng*), deer (*Cervus sp.*), goat (*Capra*), fowl (*Gallus sp.*), tortoise, and shark (*Charcharinus*) (Yulianto 1990:45; Awe 1990:91; Hardjasasmita and Mulyana 1990:155). Awe (1990:92-3) assumed that, apart from those in burial contexts, most bones belonged to food remains; some had been cut and some burned. Sofion and

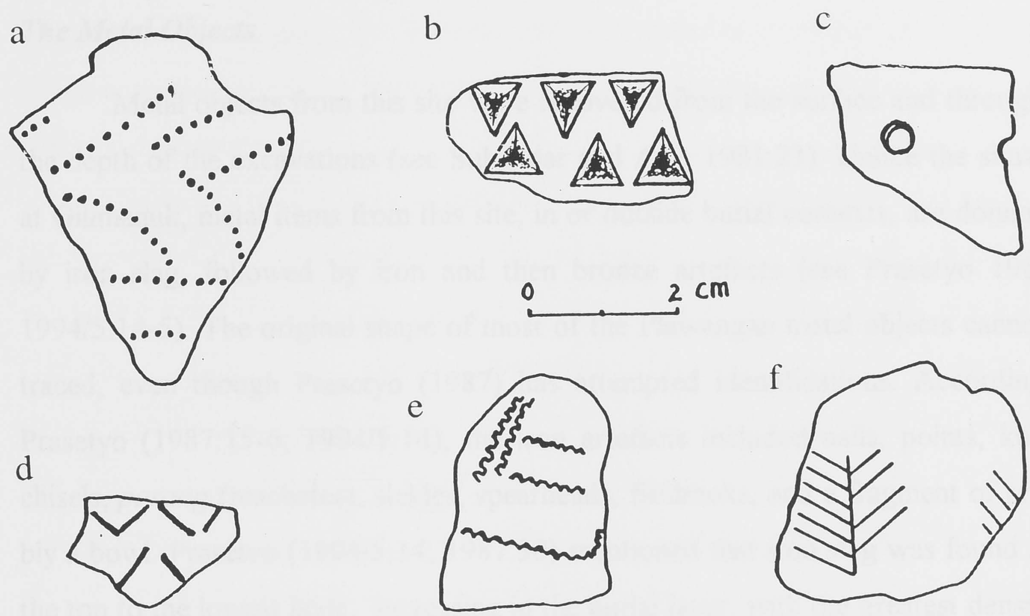


Figure 2.10. Decoration on Plawangan sherds: a. stamping; b. gouging; c. stabbing; d,e,f. incised

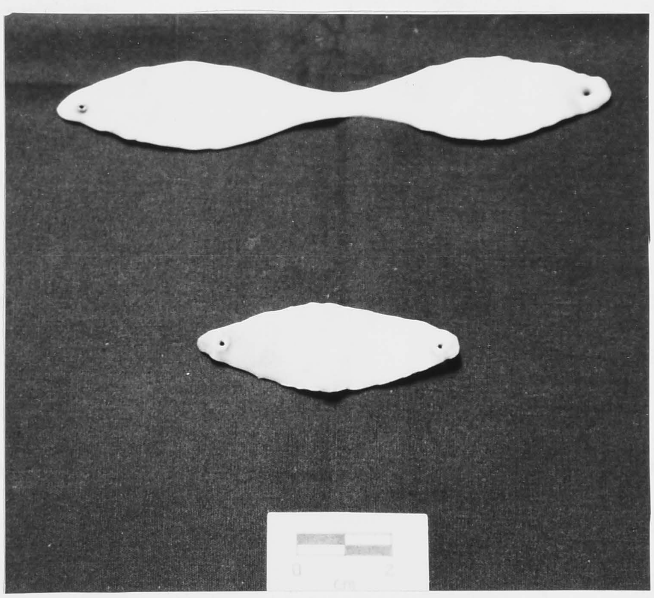


Figure 2.11. Gold-like metal foil eye and mouth covers from Plawangan.

Diniasti (1990:4) add that bone and shell tools were also apparent among the assemblages.

The Metal Objects

Metal objects from this site were recovered from the surface and throughout the depth of the excavations (see Sukendar and Awe 1981:23). Unlike the situation at Gilimanuk, metal items from this site, in or outside burial contexts, are dominated by iron slag, followed by iron and then bronze artefacts (see Prasetyo 1987:7; 1994/5:14-5). The original shape of most of the Plawangan metal objects cannot be traced, even though Prasetyo (1987) has attempted identifications. According to Prasetyo (1987:15-6; 1994/5:14), the iron artefacts included nails, points, knives, chisels, *parang* (machetes), sickles, spearheads, fishhooks, and a fragment of probably a bowl. Prasetyo (1994/5:14; 1987:30) mentioned that iron slag was found from the top to the lowest layer, increasing in the burial layer, with the greatest density in spit 6.

A number of iron objects.were also found associated with burials. They include two knives above the pelvis of skeleton number I and at the right arm of skeleton IV, a knife at the right arm of skeleton X, a spearhead and fragments of iron in burial XVI (Bintarti 1980:6), and an unidentified iron sheet with burial IX (Sukendar and Awe 1981:23). An iron fishhook was found under burial VIII, in spit 7 of excavation units J-K/29-30 in square TP.XIII. Outside burial contexts, two iron fishhooks were found in spit 7 of excavation units G-J/3_2-7_2 in square I and square II spit 6.

The bronze objects consist of points, fragments of three bracelets, a small bell, four fishhooks, a ring, fragments of sheets of bronze, Chinese coins, and a Heger I type bronze kettledrum (Prasetyo 1987:10-1; 1994/5:15). Such kettledrums have so far not been found in Gilimanuk. Used as the container for a child burial, the kettledrum is 67 cm high, and the diameter of its tympanum is 53 cm (Soegondho 1995:28-9). Four bronze fishhooks were found, one in spit 6 of square II, two from square IX layers 2 to 4 and another in test pit X spit 8 (Sukendar and Awe 1981:24; Prasetyo 1987:11, table 6), but their contexts are unknown. The rare items of gold-like metal comprise beads and eye and mouth covers (see figure 2.11). It is important to mention that, while bronze axes are numerous in Gilimanuk, it is not certain that they occur in Plawangan. Prasetyo (1987) in his analysis has not reported the appearance of bronze axes, but Bintarti (1983:81) stated that bronze axes and spearheads occurred among the Plawangan finds. Unfortunately, she did not give any associated descriptions.

Yulianto (1990:47) suggested that the absence of copper and iron sources in the vicinity of Plawangan seemingly did not handicap the Plawangan inhabitants in producing metal objects. An inherited tradition of iron working is still practiced in Gandrirejo village, 5 km south of Plawangan (Prasetyo 1994/5:6). Claiming that their ancestors came from the Plawangan area, the present iron smiths of Gandrirejo use scrap iron obtained from other places to produce tools (Prasetyo 1994/5:6-7). Considering the appearance of much iron slag in Plawangan, Bintarti (1980:11) suggested that such debris indicates ironworking in the settlement area of Plawangan. She suggested further that the number of iron objects, being more dominant than bronze, dates Plawangan to the beginning of the Christian Era or later (Bintarti 1980:13). In the case of Plawangan, future study of all the dating evidence is necessary, because several more recent cultural traits seem to overlap with the prehistoric activities. These include the appearance of possible Islamic influences in burial methods, Chinese coins and pottery, and some European materials.

A number of Chinese bronze coins were also recovered from the excavations, but mostly they were surface finds. Having been examined by Amelia (1989, appendix in Tim Penelitian Plawangan 1989), the 183 coins are mostly of Song date (AD 960 to 1279), with only one coin from the Ming. The Song coins (Amelia 1989, cited in Prasetyo 1994/5:15), as well as a bronze bracelet and a ring, were found in the first spit. However, a Chinese coin in bad condition was also found in spit 8 of square I (Prasetyo 1987:11-2). It is quite possible that this intruded into a lower layer, but further explanation is needed. Fragments of imported ceramics were recovered from the surface down to 50 cm (Prasetyo 1994/5:16). They are mostly of the Song, Yuan, Ming and Qing dynasties of China, Sawankalok and Sukothai, with some European (Prasetyo 1994/5:16).

Prasetyo (1994/5:15) stated that brass objects were also found. There are only four pieces, consisting of two points, a fragment of a bracelet, and a cylindrical hollow object 1.4 cm long by 0.04 cm wide and 5 cm diameter (Prasetyo 1987:14). A Latin inscription, "EU808", was engraved on the surface of the last object (Prasetyo 1987:14). These and other intrusive non-prehistoric types of artefacts obviously indicate that the surface and some lower levels of the Plawangan site have been disturbed by at least Chinese and European materials.

PASIR ANGIN

The Pasir Angin site is situated at Cemplang Village, Cibungbulan district, 20 km west of Bogor, western Java (Sutayasa 1979:69; Prasetyo and Diniasti 1986:327). This inland site, approximately 210 meters above sea level (Soejono 1990:219-20), covers an area at about 500 square meters, and is surrounded by Gunung Galuga, Gunung Sodong and the Cianten River (Prasetyo and Diniasti 1986:327). Forty-one squares were excavated in 1971 to 1973, 1975 and 1991 (Anggraeni and Awe 1986:349; Tim Peneliti Arkeometri 1992).

Sutayasa (1979:69) reported C14 dates for this site of 4370 ± 1190 BP (ANU-1109) and 1050 ± 60 BP (ANU-1110), both on charcoal, but noted that 'the resolution of this dating problem is not yet clear'. These dates can be calibrated to 2420 BC and AD 900. These samples were analysed by the ANU laboratory. The other two unpublished determinations are 2460 ± 440 BP (ANU-1113) and 1280 ± 170 BP (ANU-1112) (Courtesy: P. Bellwood), calibrated to 510 BC and AD 670 respectively. A dating anomaly clearly appears perhaps as a consequence of the small size of the charcoal samples, but this will not be discussed further. By considering the two dates with the smallest standard deviations, the earliest use of the Pasir Angin site probably occurred in the mid late first millennium AD.

This site has been claimed as a ceremonial site because of the presence of a large natural boulder at the top of the hill, surrounded by a number of artefacts that upon excavation were seemingly oriented in lines towards it, i.e. east-west (Anggraeni and Awe 1986:342; Soejono 1990:219-21). Some of those artefacts, found in square LP VIII, are composed of intact vessels and sherds, an iron spear-head, a gold foil mask above three Soejono II-B type bronze axes, an iron fragment and a bead (Anggraeni and Awe 1986:342-4). There is no information about the material of this bead, but Panggabean (1981:23-5) reported that until 1972, nineteen stone beads and forty-nine glass beads have been found, from 15 to 65 cm depth. In addition, Sutayasa (1979:68) also stated that 'a bronze bell, a bronze bowl, sticks of bronze with geometric ornamentation (and one with a human figure at the pointed end), gold ornaments... and a number of earthenware pots, footed vessels and several ceremonial lamps' were also found close to the large stone.

Soegondho and Azis (1986:312) suggested that the site was probably used in several successive periods, from late Neolithic, through protohistoric, historic and even into the period of Japanese colonisation (1942-1945), the letter represented by remains of fortifications. Pieces of obsidian and stone adzes have also been recovered from this site.

The pottery from this site is fragile and rough, consisting of jars, small bowls on pedestals, and cooking pots. Decoration includes impression, circle stamping and incised lines (Anggraeni and Awe 1986:342). Bronze artefacts were found in thirteen squares, from 15 to 95 cm in depth. They comprise Soejono type II-A, II-B and VII axes, a pendant, a rod, and probably a buckle (Anggraeni and Awe 1986:343). Iron objects, scattered in twenty-two squares from 15 to 85 cm depth, consist of daggers and knives, rods, spearheads, wire and other unidentified fragments (Sutayasa 1979:69; Anggraeni and Awe 1986:343). Iron slag appeared in six squares, from 15 to 95 cm depth (Anggraeni and Awe 1986:343). In addition to these objects, two bronze axes, one anthropomorphic bronze figurine, one bronze rod, a fragment of a (possibly Heger I type) bronze drum, two bronze pendants, two iron hoes, one fragment of an iron tool and three iron spearheads, were found by a villager approximately 40 to 50 cm under the surface (Tim Peneliti Arkeometri 1992). Interestingly, remains of woven *Pandanus* fiber wrapping were still retained on one iron hoe and one bronze axe, and remains of similar wrapping overlain by textile were found on both surfaces of an iron spearhead with a bronze ring at its end (Tim Peneliti Arkeometri 1992). Another iron spearhead examined by a team from the Archaeometry Section of the National Research Centre of Archaeology, Jakarta, retained remains of a wooden scabbard on its surface (Tim Peneliti Arkeometri 1992).

Chemical compositions of two bronze axes from Pasir Angin have been reported by Direktorat Geology (1973 cited in Soejono 1977:23). More recent analyses have been done by Aziz and Priyono (1997) on the 1992 finds. These include a sheet bronze fragment, part of an axe blade, part of an axe shaft, and a rod-shaped bronze fragment. The results can be seen in table 2.5.

Table 2.5. Chemical compositions of Pasir Angin bronze artefacts.
(from Soejono 1977:23, table 1; Aziz and Priyono 1997)

Composition*)	Axe 1	Axe 2	Axe 3	Axe 4	Sheet	Rod
Copper (Cu)	26.13	13.49	35.70	13.43	45.70	19.31
Lead (Pb)	0.55	0.27	1.26	0.38	21.33	42.31
Tin (Sn)	37.22	40.68	15.21	38.55	13.42	7.49
Iron (Fe)	0.18	0.20		0.28	0.39	0.63
Aluminium (Al)	1.50	1.93				
Silicate (SiO_2)	1.50	3.30	7.37			
Zinc (Zn)			0.27	0.03	0.07	0.07
Manganese (Mn)			0.004			
Nickel (Ni)						
Antimony (Sb)						
Cobalt (Co)					0.15	
Bismuth (Bi)			0.042		0.94	
"Oksida campuran"			39.944		11.984	
"Silikat dan oksida campuran"				47.48		30.31

*) all values given as percentages

Numerous sherds of Late Ming and Early Qing ceramics (ca. AD 17th century) occur scattered in thirty-four squares, from 15 to 65 cm depth, but they are absent in squares LP XXXII and LP XXXV (Anggraeni and Awe 1986:345). Some sherds found at 95 cm depth in square LP XIX B are suggested to be a result of intrusion (Anggraeni and Awe 1986:345).

Pieces of obsidian were found in almost all of the squares, from 15 to 95 cm depth (Anggraeni and Awe 1986:344). Anggraeni and Awe (1986:344) refer to cores, debitage, and pieces with use-wear. The other stone tools are stone adzes and an adze blank, found in seven squares from 15 to 65 cm depth (Anggraeni and Awe 1986:344-5). While the majority of adzes are of silicified limestone, one is a well-polished chalcedony rectangular-sectioned adze, 18 cm long, found approximately 95 cm from the surface in square LP III (Anggraeni and Awe 1986:344). Remains of bovids were reported, but only in small amounts, in spit 1 of square VIII, spit 6 of square XI and spit 2 of square XIX (Anggraeni and Awe 1986:346). Although not clearly stated, there is an indication that a small amount of human bone was also presence in this site (see Anggraeni and Awe 1986:347).

Some questions emerge from the finding of iron slag and obsidian in Pasir Angin in subsurface levels. Were these associated, and how far was the site disturbed? Although Pasir Angin is normally claimed to be site of ceremonial depositions, it is more likely that it is a burial and habitation site from which all or most human bones has disappeared because the soil is acid (see Tim Peneliti Arkeometri 1992:14, table 1).

SEMBIRAN (BALI)

Survey and excavations at Sembiran and adjacent villages in Tejakula District, such as Pacung, Bangkah and Julah, have revealed a quantity of evidence that supports trading networks and metalworking about 2000 years ago on the northeastern coast of Bali (Ardika and Bellwood 1991:221). In 1987 and 1989, eleven trenches, each 1.5 or 2 m squares were excavated by Ardika in Sembiran, and revealed a rich deposit that was supposed to be a dumping area of a settlement (Ardika and Bellwood 1991:221). The finds, recovered from between 3 and 3.5 meters under the surface, consisted of sherds of Indian Rouletted Ware, nonlocal pottery ('other imported ware'), local pottery, and beads of glass, carnelian and gold (Ardika and Bellwood 1991:223).

The result of analysis using X-ray diffraction (XRD) on one Rouletted sherd from Sembiran (SBN IV), four samples from Anuradhapura in Sri Lanka and three from Arikamedu in Tamil Nadu showed that all are almost identical in mineral composition (Ardika and Bellwood 1991:224). The XRD results, supported by neutron activation analysis (NAA) on three rouletted sherds from Sembiran, one from Pacung and nine Indian samples, strongly suggested 'an Indian origin' and 'a single manufacturing source for all the samples listed' (Ardika and Bellwood 1991:224). In addition, Ardika and Bellwood (1991:224) stated: 'The composition of the SBN IV rouletted sherd is completely different from that of soil samples from the Sembiran site and local sherds'.

The results of XRD and NAA on sherds 'black-slipped or resin glazed, sometimes carved-paddle-impressed and sometimes tempered with rice-husks', also indicated that they were not locally made, and to some extent the components were close to those of the rouletted sherds (Ardika and Bellwood 1991:224-5). The basal deposits of trench SBN VII, meanwhile, provided other supporting evidence of Indian contact. The surface of one black-slip sherd from an open dish-like vessel from this deposit has three characters of Indian script (Brahmi or Kharoshthi), that established its date as between 300 BC and AD 400 (Ardika and Bellwood 1991:225-6).

Two dates were obtained for Sembiran. The sample for the first was a rice husk tempered sherd subjected to AMS radiocarbon dating, dated to 2660 ± 100 b.p. (CAMS 723) and calibrated to 910 (818) 790 BC (Ardika and Bellwood 1991:225). The second C 14 date was from spit 25 in SBN VI, and is 1010 ± 110 BP (ANU 7218), calibrated to AD 900 (1015) 1160 (ANU 7218). This second sample was recovered 50 cm above the layer with the Rouletted Ware (Ardika and Bellwood 1991:228) and is not relevant for the material discussed here.

Nine other excavation squares that have been dug since 1990 indicate that the earlier coastline was about 200 m behind the present beach, and the most dense area of Indian pottery was approximately 130 m long by 100 m wide (Ardika et al. 1997:193-4). So far, 120 India sherds have been found, comprising Rouletted Ware and Arikamedu types 10, 18, and 141 (Ardika et al. 1997:193-4; see also Wheeler et al. 1946).

Two inhumation burials, both in flexed positions, were excavated between spits 33 and 34 in square SBN VII (Ardika 1991:38). Intact funeral gifts, however, were not found associated with the burials (Ardika 1991:38). Other finds consist of plain and decorated local sherds, glass beads, four fragments of unidentified metal object, and animal bones (Tim Ekskavasi 1995/1996).

The most important finding in relation to the development of metallurgy is a small fragment of a volcanic tuff mould with two parallel rows of engraved triangles found in association with 'pieces of bronze wire and a fragment of an iron object which could possibly be an iron harpoon' (Ardika 1991:130-1). The mould was recovered in SBN VI during the 1987-9 excavation, 3.4 m under the surface, close to rouletted sherds (Ardika and Bellwood 1991:226). Ardika and Bellwood (1991:226) further suggest: 'This probably belonged to a stamp for impressing decoration into wax during the production of a bronze drum of Pejeng type'. A broken Pejeng-type drum with similar triangle decoration was reportedly found in Pacung (McConnell and Glover 1990 cited in Ardika and Bellwood 1991:226). The dated fragment of mould from Sembiran, supported by the Manuaba specimens, promotes the idea that Pejeng-type drums were being manufactured in Indonesia from ca. AD 100 onward, contemporary with the movement of Heger I drums, presumably from northern Vietnam (Ardika and Bellwood 1991:227).

Some metal objects were recovered in Sembiran and Bangkah. Ardika (1991:133) stated that five pieces of bronze wire appeared in spit 10 of SBN I, and another piece in spit 11. Dating for spit 10 is only 770 ±180 bp (ANU 6543) (Ardika (1991:133). Seven unidentified bronze objects were found in SBN IV, VI and VII, and a truncated bicone gold bead was found in spit 36 in SBN VII (Ardika 1991:130, 133). Ardika (1991:130) claimed that the gold bead 'is very similar to specimens from Oc-Eo'. Outside Sembiran, a bronze fishhook similar to those from Plawangan and an unidentified bronze fragment were retrieved in spit 10 of square BKH I at Bangkah (Ardika (1991:132-3).

Thus, it is quite obvious that the artefacts from Sembiran and adjacent sites represent more than one source for traded commodities, these being at least India and the mainland of Southeast Asia. In this regard, these regions were possibly involved in a trading network (Ardika and Bellwood 1991:227). Ardika et al. (1997:195) proposed that local activities, such as pottery-making and bronze-working, were done in a settlement at Sembiran that was presumably situated 'inside a small and shallow embayment in the coastline, possibly adjacent to a stream'. There is also evidence for rice phytoliths in the Sembiran sediments (Ardika et al. 1997:194).

CONSIDERATION

Cultural sequences of most Early Metal Phase sites in Indonesia cannot be clearly verified because of disturbance and poor dating, but all of them seemingly developed in the first centuries of the first millennium AD. They also have clearly shared material culture as the result of wide inter-regional relationships. Each site, however, has seemingly been influenced by several different cultural flows; some cultural traits did not always appear in all the sites. The distributions of cultural traits in Java and Bali are presented in tables 2.6, 2.7. 2.8.

Table 2.6. Baked-clay artefacts from Early Metal Phase Sites in Indonesia

OBJECTS	GLM	SBN	PSA	PLW
CONTAINERS				
1. Cooking pot	x		x	x
2. Dish/platter with/without pedestal	x	x	x	x
3. Long-neck flask	x	x		
4. 'Kendi' (flask with a spout)	x			x
5. Bowl	x	x		x
6. Jar burial	x		x	x
NON-CONTAINERS				
1. Stove	x			x
2. Pot stand	x			
3. Incense burner	x		x	
4. Lid	x	x		x
5. Figurine	x			x
6. Bead	x			x
7. Bracelet	x			
8. "Net sinker"			x	x
9. 'Gacuk' (disc)	x			x
IMPORTED POTTERY				
1. Rouletted Ware		x		
2. Other Indian pottery		x		
3. Chinese ceramics	x		x	x
DECORATION				
1. Net-impression	x	x	x	?
2. Incision	x	x	x	x
3. Notching				x
4. Punched-hole		x		x
5. Dot-impression	x	x		x
6. Shell-impression	x			x
7. "Applique"	x			x
8. Red-slipping	x	x		x
9. Black-slipping		x		x
10. Corrugation	x	x		
11. Carination	x	x		x

Notes:

GLM : Gilimanuk
SBN : Sembiran
PSA : Pasir Angin
PLW : Plawangan

x : present
? : uncertain

Table 2.7. Beads and Other Tools from Early Metal Phase Sites in Indonesia

MATERIALS	GLM	SBN	PSA	PLW
BEADS :				
GLASS				
1. Mutisalah	x	x	?	x
2. Other colors	x	x	x	x
STONE			x	
1. Carnelian	x	x		
2. Agate				
a. banded agate				x
b. acid-etched agate				x
3. Limestone				x
BAKED CLAY	x			x
SHELL	x			x
GOLD	x	x		
OTHER TOOLS				
1. Stone adzes			x	
2. Stone flakes	x		x	x
3. Bone tools	x			x
4. Shell tools	x			x
5. Mortal and pestle	x			
6. Grinding stone	x		x	x

Notes:
GLM : Gilimanuk
SBN : Sembiran
PSA : Pasir Angin
PLW : Plawangan

x : present
? : uncertain

Table 2.8. Metal Objects from Early Metal Phase Sites in Indonesia

OBJECTS	GLM	SBN	PSA	PLW
BRONZE				
1. Axe	x		x	?
2. Axe with woven fiber wrapping	x		x	
3. Pentagonal Plate	x			
4. Fishhook	x	x		x
5. Earring/ring	x		x	x
6. Bracelet	x			x
7. Figurine			x	x
8. Drum (intact/fragment)	x	x	x	x
9. Decorated sheet bronze	x			
10. Pendant			x	
11. Rod			x	
12. Bowl			x	x
13. Bell			x	x
IRON				
1. Spearhead	x		x	x
2. Spearhead with bronze ring/handle	x		x	
3. Spearhead covered by wooden scabbard and/or woven fiber	x		x	
4. Knife	x		x	x
5. Hoe	x		x	
6. Hoe with woven fiber wrapping			x	
7. Sickle			?	x
8. 'Parang' (machete)				x
9. Chisel				x
10. Fishhook				x
11. Harpoon		x		
GOLD-LIKE METAL				
1. Bead	x	x		x
2. Eye cover	x			x
3. Mouth cover	x			x
4. Mask			x	
5. Cone-shaped ornament	x			
METALWORKING				
1. Bronze slag	x			
2. Iron slag	x		x	x
3. Lumped bronze ("ingot")	x			
4. Casting moulds		x		

Notes:

GLM : Gilimanuk
SBN : Sembiran
PSA : Pasir Angin
PLW : Plawangan

x : present
? : uncertain

CHAPTER 3

METAL ITEMS FROM GILIMANUK AND OTHER EARLY METAL PHASE SITES: EXAMINATION AND COMPARISONS

As the Gilimanuk site was the focus of Chapter 2, the Gilimanuk metal items, especially the bronze specimens, are examined in detail in this chapter. This will be followed by a comparison of early metal objects and indicators of metalworking from the sites discussed. The comparisons will also involve some Early Metal Phase sites in Indonesia that have not been mentioned in Chapter 2.

THE GILIMANUK BRONZE OBJECTS

As has been mentioned before, microstructural analysis of some of the Gilimanuk metal objects, by Aziz and Sudarti (1996) and Aziz and Priyono (1997), indicated that those objects were cast from scrap material. Because of this, chemical analysis will not easily provide information on the sources of the metals used, especially if scrap from different sources has been mixed together. Such a situation becomes 'a complicating factor' in analysing metal objects (see Sharer and Ashmore 1993:370).

The Gilimanuk bronze objects examined by me directly consist of fragmentary and intact artefacts stored in the National Research Centre of Archaeology, Jakarta and Bali offices. They comprise earrings, arm and leg bracelets, pentagonal plates, fishhooks, decorated sheet fragments and other unidentified bronze fragments (e.g. fragments of spiral objects), but most are axes. Some bronze artefacts mentioned in the excavation reports and other sources, cannot be found among the collections, but they will be included in the discussion.

Earrings

The six penannular bronze earrings which can be examined show solid rounded cross-sections (see figure 3.1b). Their diameter ranges from 0.97 to 1.35 cm. All

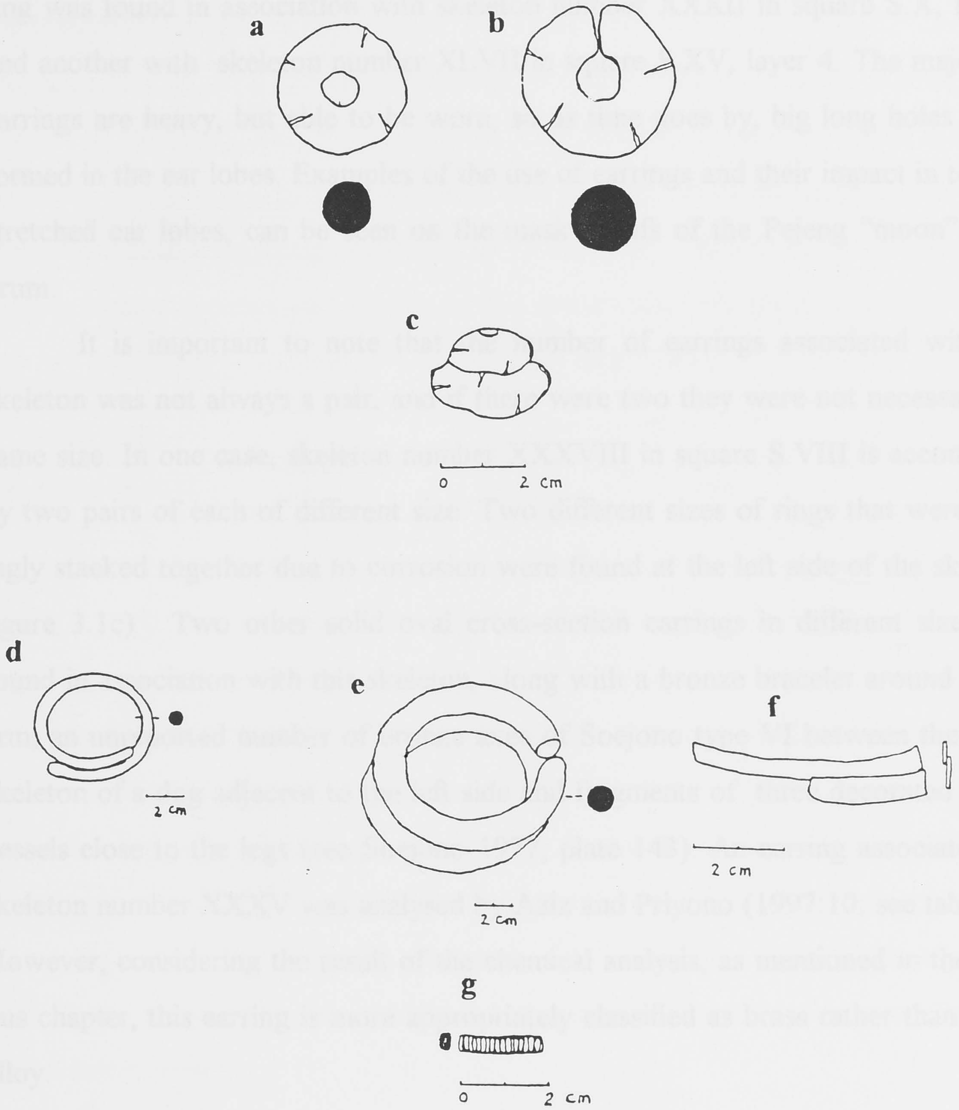


Figure 3.1. Bronze ornaments from Gilimanuk: (a) ring; (b-c) earring; (d) arm bracelet; (e) leg bracelet; (f) fragments of bracelets; (g) fragment of spiral object.

the bronze earrings were associated with human skeletons, two earrings being clearly found in position on skulls while the others were under or above skeletons. An earring was found in association with skeleton number XXXII in square S.X, layer 4, and another with skeleton number XLVII in square S.XV, layer 4. The majority of earrings are heavy, but able to be worn, so as time goes by, big long holes will be formed in the ear lobes. Examples of the use of earrings and their impact in terms of stretched ear lobes, can be seen on the mask motifs of the Pejeng "moon" kettle-drum.

It is important to note that the number of earrings associated with each skeleton was not always a pair, and if there were two they were not necessarily the same size. In one case, skeleton number XXXVIII in square S.VIII is accompanied by two pairs of each of different size. Two different sizes of rings that were seemingly stacked together due to corrosion were found at the left side of the skull (see figure 3.1c). Two other solid oval cross-section earrings in different sizes were found in association with this skeleton, along with a bronze bracelet around the left arm, an unreported number of bronze axes of Soejono type VI between the legs, a skeleton of a dog adjacent to the left side and fragments of three decorated pottery vessels close to the legs (see Soejono 1977, plate 143). An earring associated with skeleton number XXXV was analysed by Aziz and Priyono (1997:10; see table 2.3). However, considering the result of the chemical analysis, as mentioned in the previous chapter, this earring is more appropriately classified as brass rather than bronze alloy.

In addition to earrings, one bronze fully annular "ring" can be identified. Found under the waist of skeleton number VIII in square S.I, this object is solid rounded in cross section (see figure 3.1a). The diameter of the hole is only 0.70 cm, and the ring is 1.06 cm thick. This ring could not be used as an earring as there is no gap. In this case, more examples with detailed records of their original positions are needed, so that their functions can be suggested. Another bronze fragment similar to a fragment of a ring or bracelet was found in spit 8 of square S.XX(D-7). Appearing slightly curved, this fragment is 1.8 cm long, 0.44 cm wide and 0.23 cm thick. This fragment was found close to net-impressed decorated sherds.

Bracelets

Thirty six fragmentary or intact bronze bracelets were recovered from layer 3, the transition between layers 3 and 4, and layer 4 (or from spits 4 to 16). The bracelets have several sizes and cross sections: rounded-massive, rounded-hollow, plano-convex or D-shaped and thin (see figure 3.1). Some of them were found associated with arm or leg bones, so that their functions as body ornament are undoubted. They appeared in burial contexts accompanied by other body ornaments and funeral gifts, such as bronze earrings and axes, gold-like ornaments, iron spearheads, pottery vessels and glass beads (Soejono 1977, plate 148; Aziz 1983).

Pentagonal Plates

Four sets of pentagonal plates found in layers 3 to 4 in squares S.IV, S.VIII, S.XII, S.XVIII and S.XXVI of the 1964 and 1977 excavations, and one single pentagonal plate from spit 6 of square S.XXVI, have been examined in this research. This examination revealed that each set not only consisted of a single thick plate as had been mentioned before (see Soejono 1977:17), but comprised four to seven thin plates fused together. The biggest, 8.25 cm long and 7.18 wide, consists of four thin plates, each of which is approximately 0.11 to 0.21 cm thick. The smallest comprises seven thin plates, each about 0.12 cm thick, 2.1 cm long and 1.9 cm wide (see figure 3.2). So far, there are no equivalent artefacts known in other island or mainland sites of Southeast Asia.

The four sets of pentagonal plates were found under skulls or close to human skeletons as burial gifts, together with pottery vessels and beads (see Soejono 1977). The single plate, however, along with decorated fragments of bronze sheet (see figure 3.3c) and a fragment of the blade of a small bronze axe, was found outside a burial context. Considering the result of chemical analysis on similar specimens recovered from under the skull of skeleton number CXXIX in the second rescued square, Aziz and Sudarti (1996:3,7) claimed that hematite had caused the six thin pentagonal plates to become attached to one another.

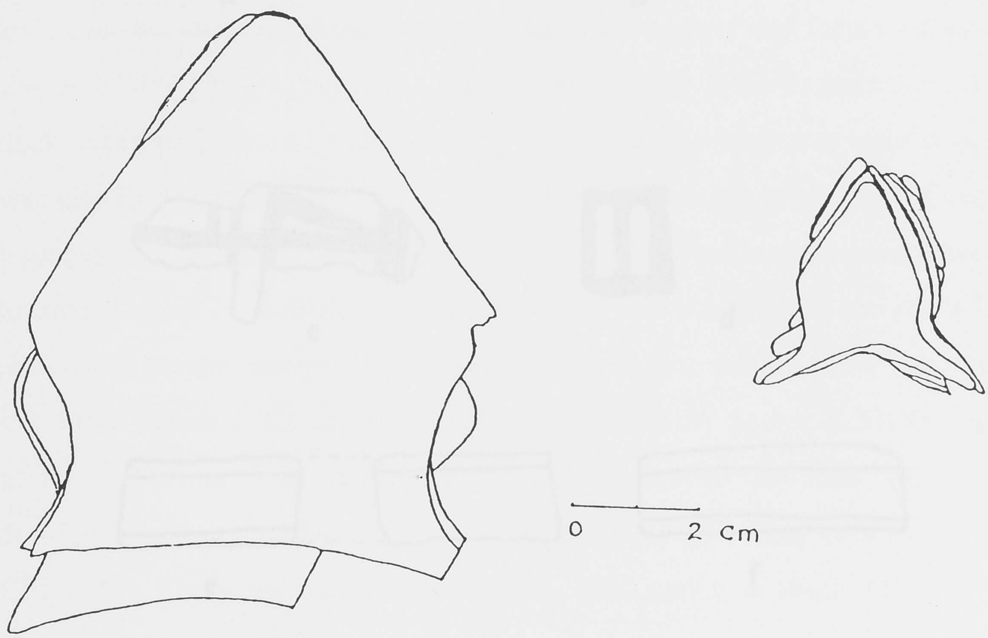


Figure 3.2. The biggest and the smallest sets of bronze pentagonal plates from Gilimanuk.

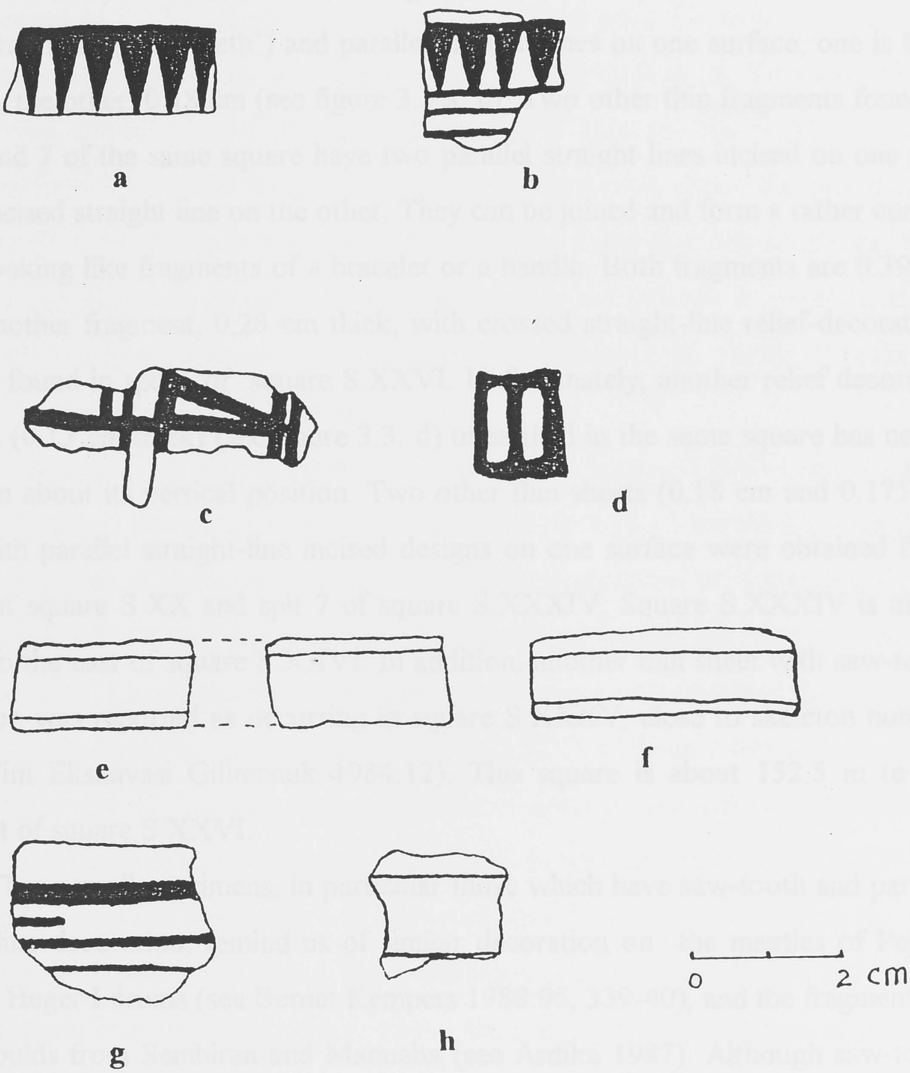


Figure 3.3. Fragments of decorated bronze sheets from several squares of excavations in Gilimanuk.

Decorated Objects

Among the metal objects examined there are a number of fragments of decorated bronze objects that are interesting to discuss. Five fragments of decorated sheet were found in square S.XXVI. Two fragments found in spit 5 and 7 have a relief band of triangles ('saw-teeth') and parallel straight lines on one surface; one is 0.12 cm thick, the other 0.18 cm (see figure 3.3 a, b). Two other thin fragments found in spits 6 and 7 of the same square have two parallel straight lines incised on one side and an incised straight line on the other. They can be joined and form a rather curved shape, looking like fragments of a bracelet or a handle. Both fragments are 0.39 cm thick. Another fragment, 0.28 cm thick, with crossed straight-line relief-decoration, was also found in spit 6 of square S.XXVI. Unfortunately, another relief decorated fragment (0.13 cm thick) (see figure 3.3. d) unearthed in the same square has no information about its vertical position. Two other thin sheets (0.18 cm and 0.175 cm thick) with parallel straight-line incised designs on one surface were obtained from spit 13 of square S.XX and spit 7 of square S.XXXIV. Square S.XXXIV is about 52.5 m to the east of square S.XXVI. In addition, another thin sheet with saw-tooth decoration was reported as occurring in square S.XXXV, close to skeleton number CIII (Tim Ekskavasi Gilimanuk 1984:12). This square is about 152.5 m to the southeast of square S.XXVI.

Those small specimens, in particular those which have saw-tooth and parallel straight-line decoration, remind us of similar decoration on the mantles of Pejeng type and Heger I drums (see Bernet Kempers 1988:95, 339-40), and the fragments of stone moulds from Sembiran and Manuaba (see Ardika 1987). Although saw-tooth decoration is not only represented on kettledrums, the thickness of these fragments is approximately equal to that of the mantle of a kettledrum. After examining the decoration on a Heger I type drum stored in the National Research Centre of Archaeology, Jakarta, and considering the flatness of the fragments, I suggest that the rows of saw teeth are oriented vertically come from the mantles of drums. In addition, the size of the saw-tooth decoration of the specimens from Gilimanuk, that is 9 mm and 10 mm high, is comparable to that on the Sembiran mould fragment (8 mm high) (see Ardika 1991:130). Considering these similarities, the five decorated fragments from spits 5 to 7 in square S.XXVI (see figure 3.3: a-c, e, f) may be assumed to be fragments of a kettledrum. The other decorated specimens are more difficult to interpret as they were found scattered.

Bernet Kempers (1988:73) has reminded us of the possibility that kettledrums were smashed or "killed" before being used as funeral gifts. Cases of such practice have been reported from several places, such as Shizhaishan (in Yunnan) and the ethnographic Karen (Bernet Kempers 1988:73). If this so, the small decorated specimens from Gilimanuk would provide new information about the existence of fragments of kettledrums in this site. Unfortunately, those few tiny fragments were recovered outside burial contexts. Consequently, it is still difficult to conclude that a tradition of smashing drums was also occurring in Gilimanuk in relation to burial activities, but I will discuss it further below.

Found with the decorated bronze fragments in square S.XXVI, spits 5 to 7, were fragments of bronze axes, a small pentagonal plate (0.15 cm thick), a fragment of an iron object, a skeleton of a dog under a concentration of decorated sherds, pottery vessels, beads, a fragment of an unidentified animal leg, and unidentified bones and teeth. Clear indications of human burials were only obtained deeper in spit 11 and 12. Skeletons of R. LXXXVII and R. LXXXVIII, an adult and an infant, were found in spit 11, together with a fragment of a bronze axe and two small bronze sheet fragments, three pottery vessels and beads. In spit 12, skeleton LXXXVI was found with bronze axe fragments and a sheet-shaped fragment. Considering the variety of finds above the burial layers, the explanation proposed here is that other burial activities might also have taken place above them in spits 5 to 7. These upper spits could possibly have been disturbed.

As a whole, therefore, bronze objects were recovered in square S.XXVI from top to bottom of the excavation. Two fragments of small bronze axes were revealed in the first spit, and a fragment of a Chinese coin was recovered in the third. Moreover, examination of the fragments of metal objects from all spits showed that very few of them can be reconstructed. This seems to support the argument that the layers above the intact burials in square S.XXVI had been disturbed. Considering the existence of the small fragments of bronze objects in the burial layer, the most likely explanation is that they were intruded accidentally together with soil which was replaced in the grave pit alter the burial.

Fishhooks

Twelve fragments of bronze fishhooks were recovered in Gilimanuk, from spit 5 to spit 12, without any indication of burial context. Those fragments can be recognised as parts of fishhooks based on the appearance of pointed hook tips. The size and fragility of such fishhooks may cause these artefacts rarely be found complete. It is important to note that a number of rounded small bronze rods similar to the stems of fishhooks also occur among the fragments of metal objects. In this case, however, to assume that such items are fragments of fishhooks is not very persuasive due to the absence of pointed ends.

Socketed Axes

Glover and Syme (1993:66) have noted that 'the term 'axe' is used in a purely formal and conventional way, ... for there is little evidence that they were used as are axes today, and some to show that they were not'. In my research, 176 intact or fragments of socketed bronze axes are examined. The fragments consist of shafts, blades and fragments of proximal ends (figure 3.4). None of the axes examined has any decoration. Some have been included in the Indonesian bronze axe classification proposed by Soejono (1972), as Soejono types V and VI (see Soejono 1977; Aziz 1983).

Variations of morphology and size in the Gilimanuk axes have become the focus of my research. The types proposed by Soejono (1972) will still be used. Some of the terms used by Soejono (1972) and some other terms derived from stone tool terminology are applied in describing the components of axes (see figure 3.4). At this stage statistical analysis is difficult to do, as the number of specimens is small and most of them are broken and cannot be measured in exactly the same way. However, complete measurements and ratios which often survive include: (1) maximum length; (2) maximum width; (3) ratio between maximum length and maximum

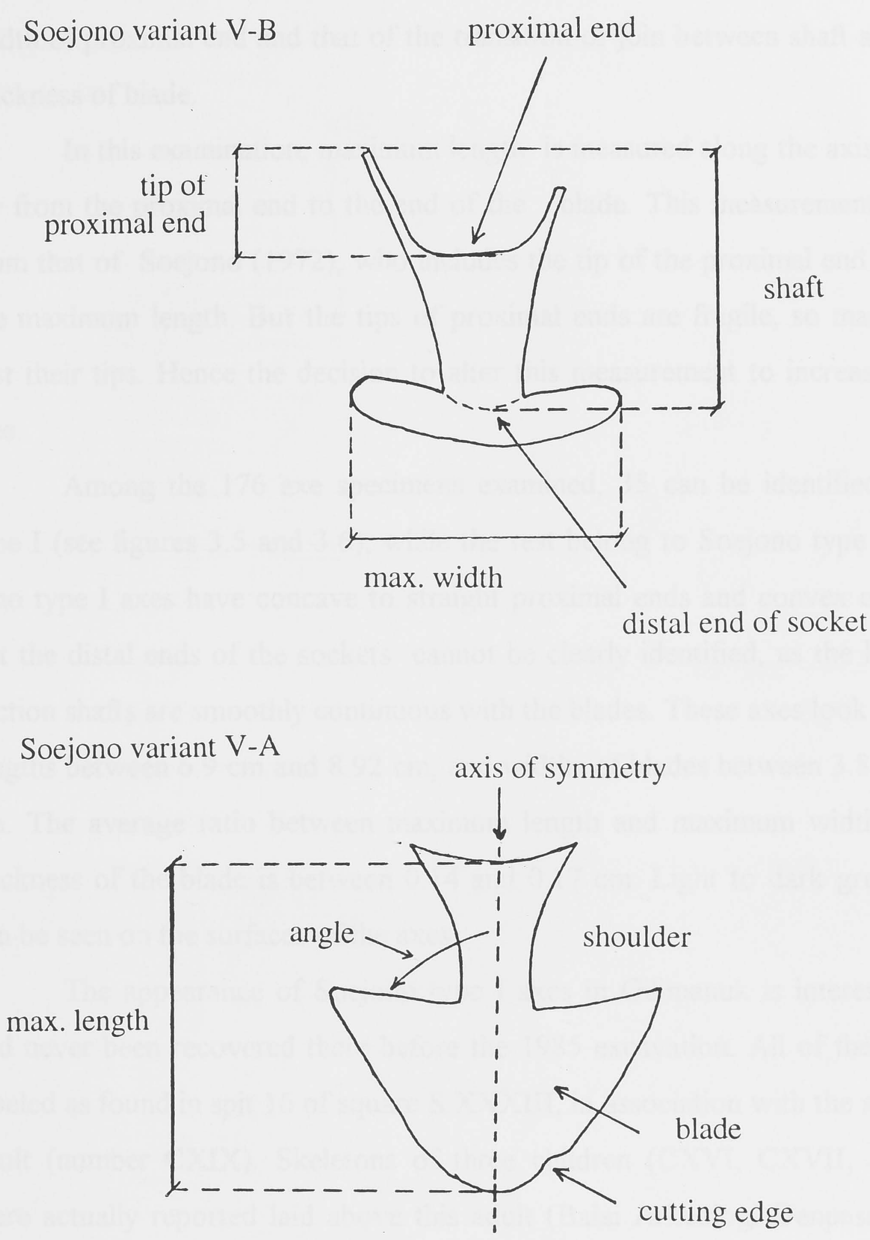


Figure 3.4. Terminology of components of bronze axes used in this thesis.

width; (4) angle between the axis of symmetry and the shoulder; (5) ratio between width of proximal end and that of the transition or join between shaft and blade; (6) thickness of blade.

In this examination, maximum length is measured along the axis of symmetry from the proximal end to the end of the blade. This measurement is different from that of Soejono (1972), who includes the tip of the proximal end in measuring the maximum length. But the tips of proximal ends are fragile, so many axes have lost their tips. Hence the decision to alter this measurement to increase the sample size.

Among the 176 axe specimens examined, 35 can be identified as Soejono type I (see figures 3.5 and 3.6), while the rest belong to Soejono type V. The Soejono type I axes have concave to straight proximal ends and convex cutting edges, but the distal ends of the sockets cannot be clearly identified, as the lentoid cross-section shafts are smoothly continuous with the blades. These axes look slender, with lengths between 6.9 cm and 8.92 cm, and widths of blades between 3.8 cm and 5.58 cm. The average ratio between maximum length and maximum width is 8:5. The thickness of the blade is between 0.14 and 0.17 cm. Light to dark green corrosion can be seen on the surfaces of the axes.

The appearance of Soejono type I axes in Gilimanuk is interesting, as they had never been recovered there before the 1985 excavation. All of these axes were labeled as found in spit 16 of square S.XXXIII, in association with the skeleton of an adult (number CXIX). Skeletons of three children (CXVI, CXVII, and CXVIII) were actually reported laid above this adult (Balai Arkeologi Denpasar 1985), but there is no information as to whether the axes were associated only with the adult, or with all four skeletons.

Mardika (1990, map 2) stated that, as well as in Gilimanuk, the Soejono type I occur in other sites in Bali, such as Tigawasa, Yeh Sumbul (Mendoyo), Pujungan, Keramas, and Tohpati. However, the differences or similarities with the Gilimanuk axes have not been elucidated. I believe that this is a comparison important to do in the future, as the Soejono type I, the common or basic type of Indonesian bronze axe (see Soejono 1972, plate 1), has several variants. Besides, the appearance of such

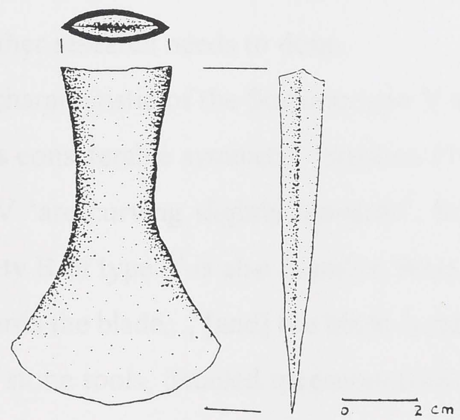


Figure 3.5. A Soejono type I axe from Gilimanuk.
(drawn by Sektiadi).

Figure 3.6. Soejono type I axes found with skeleton CXIX in Gilimanuk.

axes in Gilimanuk triggers questions. Why was this type only associated there with one burial? Were they imported from other regions outside Bali? If they were imported, what other clues are there for such importation? These questions can not be answered here, and further research needs to done.

The important characteristic of the Soejono type V axe, which is the common type in Gilimanuk, is its considerable symmetry. Soejono (1972:5) has stated that the shoulders of the type V 'are curving slightly upwards'. Soejono (1972:5, figure 3) further stated that variety B of type V is also found in West Irian, but 'the side of the shaft runs straight towards the blade..., [and] the blade is rather thick'.

As in analysing stone tools, detailed measurements on bronze axes may indicate certain attribute patterns that cannot be recognised at a glimpse. By measuring intact axes and fragments I believe that three other distinct formal variants of the Soejono type V axe can be acknowledged, besides variants V-A and V-B. The measurements taken to demonstrate this are: (1) ratio between maximum length and maximum width; (2) angle between the axis of symmetry and the shoulder; (3) ratio between width of the proximal end and the transition between shaft and blade. The three variants, i.e. Variant 1, Variant 2 and Variant 3, were not mentioned by Soejono (1972) in his descriptions of types of axes. In the following text the new variants recognised are termed Anggraeni variants 1, 2, and 3. The measurements and characteristics of these three variants can be seen in tables 3.1 and 3.2. Some fragmentary specimens and specimens without clear information on context, were not included in the examination. The distribution of bronze axes in each spit and layer can be seen in table 3.3 and figure 3.7 (spits), and table 3.4 and figure 3.8 (layers).

The distinctive characteristics to differentiate the Soejono variant V-A from other variants are the absence of the two elongated tips at the proximal end and a bigger shaft. Although no intact specimen of Soejono variant V-A exists in the Gilimanuk assemblage, fragments of shafts and blades can be distinctly recognised (see figure 3.9). The shaft lengths of nine specimens are between 6.5 and 10 cm. Overall shape reconstruction can only be done on the remnants of one half of an axe, while another eight shafts and eight separate pieces of blade cannot be reconstructed. The thicknesses of the blades are between 0.18 and 0.32 cm. The angles between

Table 3.1. Measurements of Gilimanuk type V bronze axes

Sample	Code	Length 1*	Length 2*	Width 1*	Width 2*	Width 3*	Angle**	Variant
1	GLM/64/S.XIII/L.3-No.219	8.5			6.1	3.1		V-A
2	GLM/64/S.V/L.3-No.223	7.1			5.25	2.95		V-A
3	GLM/64/S.XIII/L.4-No.209	9.3			6.2	4		V-A
4	GLM/64/S.XIII/L.4-No.209	6.5			4.5	2.7		V-A
5	GLM/64/S.XII/L.3-No.236	9.6			7.1	5.6		V-A
6	GLM/64/S.XVII/L.3/4-No.144	7.4			5.4	3.2		V-A
7	GLM/64/S.IV/L.4-No.206	9.4			4.7	2.5		V-A
8	GLM/64/S.IV/L.4-No.206	8.1			5	2.4		V-A
9	GLM/73/S.XXII/K.D14/Sp.16-No.43			p.16		p.3.4	p.60	V-A
10	GLM/64/S.XVII/L.3/4-No.155	0.8		p.11.2	3.5	2.4	90	3
11	GLM/77/S.XXVI/Sp.11-No.19	2.3			2.5	2.4		3
12	GLM/77/S.XXVI/Sp.12-No.22	1	3.5	p.9	2	1.6	80	3
13	GLM/77/S.XXVI/Sp.12-No.22	1.2	4.5	p.11	2.4	2.2	80	3
14	GLM/64/S.XVII/L.3/4-No.146	1.2			2.6	2.4		3
15	GLM/77/S.XX/Sp.12	1.6			2	1.8		3
16	GLM/64/S.X/L.4-No.168	2			2.1	1.95	p.90	3
17	GLM/84/S.XXXIV/Sp.22-No.57	4.5	5.25	7.65	2.7	2.1	80	1
18	GLM/84/S.XXXIV/Sp.22-No.57	4.5	5.25	7.65	2.7	2.1	80	1
19	GLM/73/S.XXI/K.B6-No.47	5.4			p.3.6	p.2.4		1
20	GLM/73/S.XXI/K.B6-No.47	5.7			3	2.1		1
21	GLM/64/S.IX/L.3-No.186				2.55			1
22	GLM/64/S.IX/L.3-No.186	4.8			2.5	1.7		1
23	GLM/64/S.IX/L.3-No.186	4.7			2.8	1.8		1
24	GLM/64/S.IV/L.4-No.206	5.6			3.4	2.1		1
25	GLM/64/S.X/L.4-No.180	p.4.8			1.9	1.5	p.90	1
26	GLM/64/S.X/L.4-No.180				1.7	1.6		1
27	GLM/64/S.XIII/L.4-No.339	9.4			2.8	3.2		1
28	GLM/73/S.XXII/K.D14/Sp.16	5.8			3.4	2		1
29	GLM/79/S.XXVII/Sp.18-No.44	3.9			3.25	2.6		1
30	GLM/73/S.XXI/K.A12/Sp.11-No.1	5.8			3.15	2.3		1

* All values in centimeters

** All values in degrees

Table 3.1. Continued

Sample	Code	Length 1*	Length 2*	Width 1*	Width 2*	Width 3*	Angle**	Variant
31	GLM/73/S.XXI/K.A12/Sp.11-No.1	5.5			p.2.8	2		1
32	GLM	5.9			3.5	2.2		1
33	GLM	5.8			3.4	2.5		1
34	GLM	6.3			4	2.4		1
35	GLM/79/S.XXVII/Sp.18-No.43	3.3	3.9	p.6	3.05	1.7	p.90	1
36	GLM/73/S.XXII/K.D13/Sp.15-No.42	3	3.7	p.5	2.7	1.5	80	V-B
37	GLM/64/S.XII/L.3b-No.258	4.2	5.2	p.5	3.55	1.8	90	V-B
38	GLM/79/S.XXVII/Sp.19	3.4			p.2.5	1.25		V-B
39	GLM/77/S.XXIV/Sp.6	3.4			2.5	p.1.15		V-B
40	GLM/77/S.XXIV/Sp.6	3.3			2.3	1.2		V-B
41	GLM/77/S.XXIV/Sp.17-No.29	3.65			p.2.5	p.1.3		V-B
42	GLM/77/S.XXIV/Sp.17-No.29	3.3			p.2.75	p.1.4		V-B
43	GLM/77/S.XXIV/Sp.17-No.29	3.6			p.2.4	p1.4		V-B
44	GLM/79/S.XXVIII/Sp.18-No.24	2.7			2.7	1.8		2
45	GLM/77/S.XXV/Sp.8	2.5			1.9	0.9		2
46	GLM/73/S.XXII/K.D13/Sp.15-No.42	1.9	2.5	p.5	2.2	0.9	90	2
47	GLM/73/S.XXII/K.D13/Sp.15-No.42	2.1	2.6	p.4	2.1	p.0.8	p.90	2
48	GLM/73/S.XXII/K.D13/Sp.15-No.42	2.35	3.25	p.6	1.9	0.9	90	2
49	GLM/77/S.XXIV/Sp.7	0.9			1	0.4		2
50	GLM/77/S.XXIV/Sp.7	1.3			0.95	0.4		2
51	GLM/77/S.XXVI/Sp.7	1.4			1.45	0.8		2
52	GLM/77/S.XXVI/Sp.7	1.3			p.1.4	p.0.4		2
53	GLM/77/S.XXIV/Sp.9	1.2	1.7	p.2.2	1.25	0.6	90	2
54	GLM/77/S.XXIV/Sp.9	1.6			1.3	0.4		2
55	GLM/77/S.XXIV/Sp.9	1			p.1.2	0.4		2
56	GLM/73/S.XXI/K.D7/Sp.9	1.2	1.8		1.4	0.8		2
57	GLM/73/S.XXI/K.D7/Sp.9	1.4			1.5	0.7		2
58	GLM/73/S.XXI/K.D6/Sp.8	1.4	1.8		p.1.2	0.8	90	2
59	GLM/73/S.XXI/K.D6/Sp.8	1.05	1.3		0.9	0.35		2
60	GLM/77/S.XXVI/Sp.5	1			p.1.1	p.0.4		2

* All values in centimeters

** All values in degrees

Table 3.1. Continued

Sample	Code	Length 1*	Length 2*	Width 1*	Width 2*	Width 3*	Angle**	Variant
61	GLM/77/S.XXIV/Sp.8	1.1			p.1.05	0.3		2
62	GLM/77/S.XXIV/Sp.8	0.95			p.1.1	0.5		2
63	GLM/77/S.XXIV/Sp.8	1			1.1	0.4		2
64	GLM/77/S.XXIV/Sp.8	1.1	1.4		0.9	0.6	90	2
65	GLM/77/S.XX/Sp.10	1.4	1.8		p.1.2	0.7	p.90	2
66	GLM/77/S.XX/Sp.10	0.9			1.2	0.4		2
67	GLM/84/S.XXXIV/Sp.12	1.2	1.5	2.2	1.15	0.6	90	2
68	GLM/73/S.XXII/K.D14/Sp.16-No.43	1.7			1.9	p.1		2
69	GLM/73/S.XXI/K.A6/Sp.8	1.1			1	0.45		2
70	GLM/73/S.XXII/K.A7/Sp.9	1.05			1.1	p.0.6		2
71	GLM/77/S.XXIV/Sp.13	1	1.4	p.2	p.1	0.9	p.90	2
72	GLM/77/S.XXIV/Sp.11	1.2			1.2	0.6		2
73	GLM/77/S.XXIV/Sp.11	.1.1	1.6	p.1.4	0.8	0.5	90	2
74	GLM/73/S.XXII/K.B8/Sp.10	1.1			1.2	0.55		2
75	GLM/73/S.XXII/K.B8/Sp.10	1.2			1.3	0.6		2
76	GLM/73/S.XXI/K.C5/Sp.7	1.1			p.1.3	0.6		2
77	GLM/77/S.XXV/Sp.3	0.79			0.7	0.2		2
78	GLM/77/S.XXIV/Sp.10	0.85	1.4	2.6	0.63	0.75	90	2
79	GLM/79/S.XXVIII/Sp.5	1.1			1.05	0.4		2
80	GLM/79/S.XXVIII/Sp.5	1.25			1.2	0.4		2
81	GLM/77/S.XXV/Sp.7	1.3			1.2	0.4		2
82	GLM/73/S.XXII/K.D.10/Sp.12	1.8			1.1	0.3		2
83	GLM/73/S.XXII/K.D.10/Sp.12	0.6			0.65	0.2		2
84	GLM/79/S.XXX/Sp.17	0.94			0.95	0.2		2
85	GLM/64/S.XII/L.3-No.70	1.4			1.35	0.3		2
86	GLM/77/S.XXVI/Sp.4	1.2			1.1	0.4		2
87	GLM	1.4			1.4	0.6		2
88	GLM/73/S.XXI/K.C11/Sp.13	1.55			1.2	0.45		2
89	GLM/77/S.XX/Sp.13	1.1			1.05	0.3		2
90	GLM/77/S.XXIV/Sp.12	1.3			1.4	0.4		2

* All values in centimeters

** All values in degrees

Table 3.1. Continued

Sample	Code	Length 1*	Length 2*	Width 1*	Width 2*	Width 3*	Angle**	Variant
91	GLM/79/S.XXVII/Sp.8	1.5			1.5	0.5		2
92	GLM/79/S.XXVII/Sp.13	1.5			1.3	0.4		2
93	GLM/84/S.XXXIV/Sp.9	1.2			1.3	0.3		2
94	GLM/84/S.XXXIV/Sp.16	1.7			1.7	0.9		2
95	GLM/84/S.XXXIV/Sp.10	1			1.1	0.4		2
96	GLM/84/S.XXXIV/Sp.6	1.3			1.3	0.5		2
97	GLM/84/S.XXXIV/Sp.6	1.4			1.1	0.3		2
98	GLM/84/S.XXXIV/Sp.9	1			1.1	0.4		2
99	GLM/77/S.XXIII/Sp.6	0.7			1.9	0.4		2
100	GLM/79/S.XXVII/Sp.9	1.5			p.1.5	0.4		2
101	GLM/73/S.XXII/K.D6/Sp.8	1.55			p.1.6	0.6		2
102	GLM/77/S.XXIV/Sp.17	1			p.0.8	0.4		2

* All values in centimeters

** All values in degrees

Note:

Length 1 : proximal end to distal end of socket
Length 2 : proximal end to cutting edge
Width 1 : width of blade
Width 2 : width of proximal end
Width 3 : width of shaft, at the join between shaft and blade
Angle : angle between axis of symmetry and shoulder
GLM : Gilimanuk
S. : grid square
L. : layer
Sp. : spit
K. : excavation unit
p. : size predicted from surviving shape

Table 3.2. Metrical characteristics of the variants of Soejono type V axes from Gilimanuk

Sample	Code	Variant	Shaft						Blade	
			1	2	3	4	5	6	1	2
1	GLM/64/S.XIII/L.3-No.219	V-A	x			x	x		p.x	
2	GLM/64/S.V/L.3-No.223	V-A	x			x	x			
3	GLM/64/S.XIII/L.4-No.209	V-A	x			x	x			
4	GLM/64/S.XIII/L.4-No.209	V-A	x			x	x		p.x	
5	GLM/64/S.XII/L.3-No.236	V-A	x			x	x			
6	GLM/64/S.XVII/L.3/4-No.144	V-A	x			x	x			
7	GLM/64/S.IV/L.4-No.206	V-A	x			x	x		p.x	
8	GLM/64/S.IV/L.4-No.206	V-A	x			x	x		p.x	
9	GLM/73/S.XXII/K.D14/Sp.16-No.43	V-A	x			x	x		x	
10	GLM/64/S.XVII/L.3/4-No.155	3		x	p.x		x		x	
11	GLM/77/S.XXVI/Sp.11-No.19	3		x	p.x		x			
12	GLM/77/S.XXVI/Sp.12-No.22	3		x	p.x		x		x	
13	GLM/77/S.XXVI/Sp.12-No.22	3		x	p.x		x		x	
14	GLM/64/S.XVII/L.3/4-No.146	3		x	p.x		x			
15	GLM/77/S.XX/Sp.12	3		x	p.x		x			
16	GLM/64/S.X/L.4-No.168	3		x	p.x		x			
17	GLM/84/S.XXXIV/Sp.22-No.57	1	x		x		x			x
18	GLM/84/S.XXXIV/Sp.22-No.57	1	x		x		x			x
19	GLM/73/S.XXI/K.B6-No.47	1	x		x		x			
20	GLM/73/S.XXI/K.B6-No.47	1	x		x		x			p.x
21	GLM/64/S.IX/L.3-No.186	1	x		x		x			
22	GLM/64/S.IX/L.3-No.186	1	x		p.x		x			
23	GLM/64/S.IX/L.3-No.186	1	x		x		x			
24	GLM/64/S.IV/L.4-No.206	1	x		x		x			p.x
25	GLM/64/S.X/L.4-No.180	1	x		x		x			
26	GLM/64/S.X/L.4-No.180	1	x		x		x			
27	GLM/64/S.XIII/L.4-No.339	1	x		x		x			
28	GLM/73/S.XXII/K.D14/Sp.16-No.43	1	x		x		x			
29	GLM/79/S.XXVII/Sp.18-No.44	1	x		x		x			
30	GLM/73/S.XXI/K.A12/Sp.11-No.1	1	x		x		x			
31	GLM/73/S.XXI/K.A12/Sp.11-No.1	1	x		x		x			
32	GLM	1	x		x		x			
33	GLM	1	x		x		x			
34	GLM	1	x		x		x			
35	GLM/79/S.XXVII/Sp.18-No.43	1	x		x		x			x
36	GLM/73/S.XXII/K.D13/Sp.15-No.42	V-B	x		x			x		x
37	GLM/64/S.XII/L.3b-No.258	V-B	x		x			x		x
38	GLM/79/S.XXVII/Sp.19	V-B	x		x			x		
39	GLM/77/S.XXIV/Sp.6	V-B	x		x			x		
40	GLM/77/S.XXIV/Sp.6	V-B	x		p.x			x		
41	GLM/77/S.XXIV/Sp.17-No.29	V-B	x		p.x			x		
42	GLM/77/S.XXIV/Sp.17-No.29	V-B	x		p.x			x		
43	GLM/77/S.XXIV/Sp.17-No.29	V-B	x		p.x			x		
44	GLM/79/S.XXVIII/Sp.18-No.24	2		x	x			x		
45	GLM/77/S.XXV/Sp.8	2		x	x			x		

Table 3.2. Continued

Sample	Code	Variant	Shaft						Blade	
			1	2	3	4	5	6	1	2
46	GLM/73/S.XXII/K.D13/Sp.15-No.42	2		x	p.x			x		
47	GLM/73/S.XXII/K.D13/Sp.15-No.42	2		x	x			x		
48	GLM/73/S.XXII/K.D13/Sp.15-No.42	2		x	x			x		
49	GLM/77/S.XXIV/Sp.7	2		x	x			x		
50	GLM/77/S.XXIV/Sp.7	2		x	x			x		
51	GLM/77/S.XXVI/Sp.7	2		x	x			x		
52	GLM/77/S.XXVI/Sp.7	2		x	p.x			x		
53	GLM/77/S.XXIV/Sp.9	2		x	x			x		x
54	GLM/77/S.XXIV/Sp.9	2		x	x			x		
55	GLM/77/S.XXIV/Sp.9	2		x	p.x			x		
56	GLM/73/S.XXI/K.D7/Sp.9	2		x	x			x		p.x
57	GLM/73/S.XXI/K.D7/Sp.9	2		x	x			x		
58	GLM/73/S.XXI/K.D6/Sp.8	2		x	x			x		p.x
59	GLM/73/S.XXI/K.D6/Sp.8	2		x	x			x		p.x
60	GLM/77/S.XXVI/Sp.5	2		x	x			x		
61	GLM/77/S.XXIV/Sp.8	2		x	p.x			x		
62	GLM/77/S.XXIV/Sp.8	2		x	p.x			x		
63	GLM/77/S.XXIV/Sp.8	2		x	x			x		
64	GLM/77/S.XXIV/Sp.8	2		x	p.x			x		x
65	GLM/77/S.XX/Sp.10	2		x	p.x			x		x
66	GLM/77/S.XX/Sp.10	2		x	x			x		
67	GLM/84/S.XXXIV/Sp.12	2		x	x			x		x
68	GLM/73/S.XXII/K.D14/Sp.16-No.43	2		x	x			x		
69	GLM/73/S.XXI/K.A6/Sp.8	2		x	x			x		
70	GLM/73/S.XXII/K.A7/Sp.9	2		x	x			x		
71	GLM/77/S.XXIV/Sp.13	2		x				x		x
72	GLM/77/S.XXIV/Sp.11	2		x	x			x		
73	GLM/77/S.XXIV/Sp.11	2		x				x		x
74	GLM/73/S.XXII/K.B8/Sp.10	2		x	x			x		
75	GLM/73/S.XXII/K.B8/Sp.10	2		x	x			x		
76	GLM/73/S.XXI/K.C5/Sp.7	2		x	x			x		
77	GLM/77/S.XXV/Sp.3	2		x	x			x		
78	GLM/77/S.XXIV/Sp.10	2		x	x			x		x
79	GLM/79/S.XXVIII/Sp.5	2		x	x			x		
80	GLM/79/S.XXVIII/Sp.5	2		x	x			x		
81	GLM/77/S.XXV/Sp.7	2		x	x			x		
82	GLM/73/S.XXII/K.D.10/Sp.12	2		x	x			x		
83	GLM/73/S.XXII/K.D.10/Sp.12	2		x	x			x		
84	GLM/79/S.XXX/Sp.17	2		x	x			x		
85	GLM/64/S.XII/L.3-No.70	2		x	x			x		
86	GLM/77/S.XXVI/Sp.4	2		x	x			x		
87	GLM	2		x	x			x		
88	GLM/73/S.XXI/K.C11/Sp.13	2		x	p.x			x		
89	GLM/77/S.XX/Sp.13	2		x	x			x		
90	GLM/77/S.XXIV/Sp.12	2		x	x			x		

Table 3.2. Continued

Sample	Code	Variant	Shaft						Blade	
			1	2	3	4	5	6	1	2
91	GLM/79/S.XXVII/Sp.8	2		x	x			x		
92	GLM/79/S.XXVII/Sp.13	2		x	x			x		
93	GLM/84/S.XXXIV/Sp.9	2		x	x			x		
94	GLM/84/S.XXXIV/Sp.16	2		x	x			x		
95	GLM/84/S.XXXIV/Sp.10	2		x	p.x			x		
96	GLM/84/S.XXXIV/Sp.6	2		x	x			x		
97	GLM/84/S.XXXIV/Sp.6	2		x	p.x			x		
98	GLM/84/S.XXXIV/Sp.9	2		x	x			x		
99	GLM/77/S.XXIII/Sp.6	2		x	p.x			x		
100	GLM/79/S.XXVII/Sp.9	2		x	x			x		
101	GLM/73/S.XXII/K.D6/Sp.8	2		x	x			x		
102	GLM/77/S.XXIV/Sp.17	2		x	p.x			x		

Note:

Shaft:
1. Long : equal to or more than 3 cm long.
2. Short : equal to or less than 2.9 cm long.
3. Deep-curved proximal end with elongated tips.
4. Shallow-curved proximal end, without elongated tips.
5. Both sides are parallel, then diverge when closer to proximal end (see figure 3.10 a).
6. Both sides diverge from the join of shaft and blade toward the tip (see figure 3.10 c).

Blade:
1. Long : the vertical length of the blade is approximately 50 % to 70 % of the total length (see figure 3.9 and 3.11).
2. Short : the vertical length of the blade is approximately 15 % to 25 % of the total length (see figure 3.10).

x : present
p.x : predicted from fragments

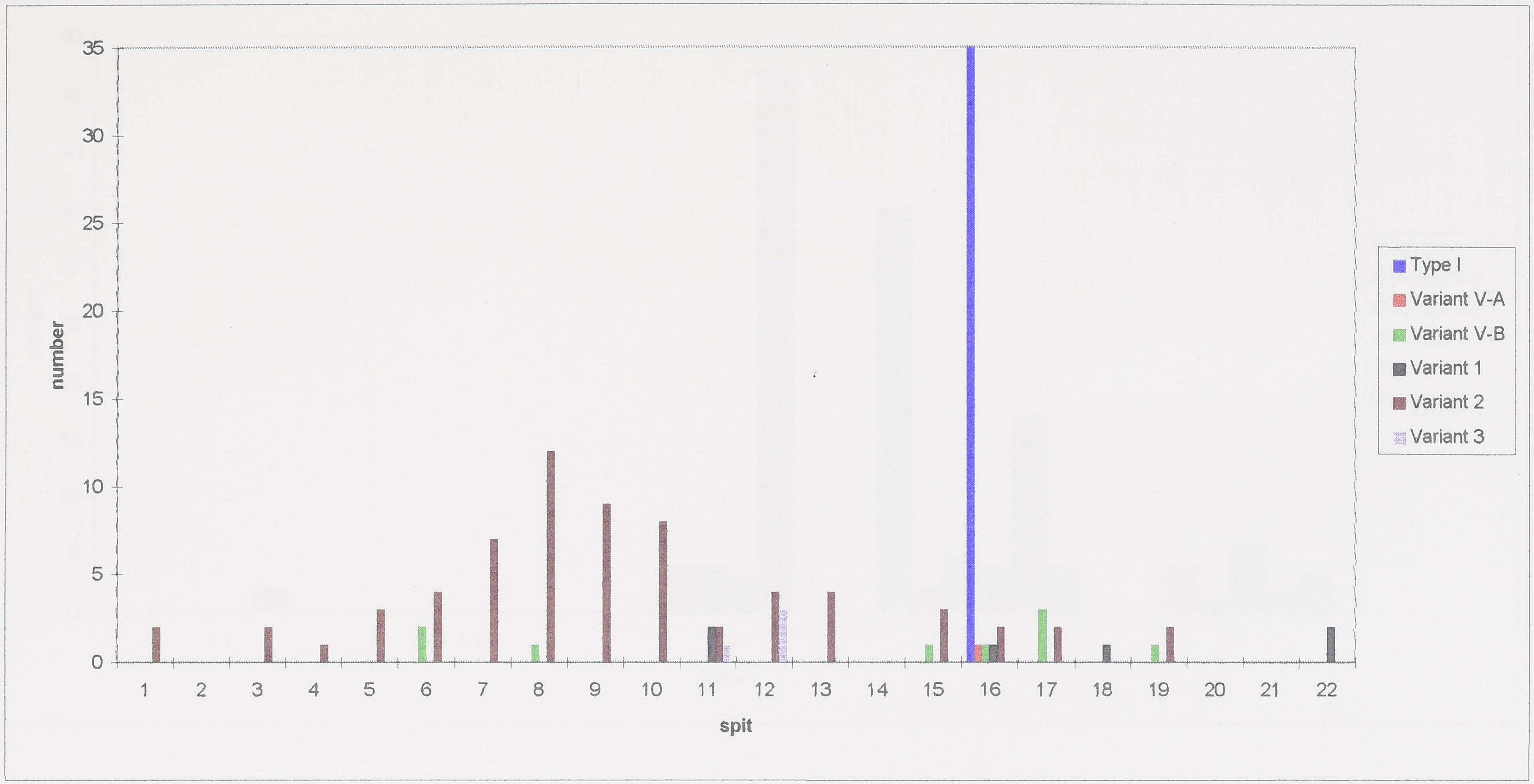


Figure 3.7. Bar chart showing the distribution of bronze axes in the Gilimanuk site, by spit.

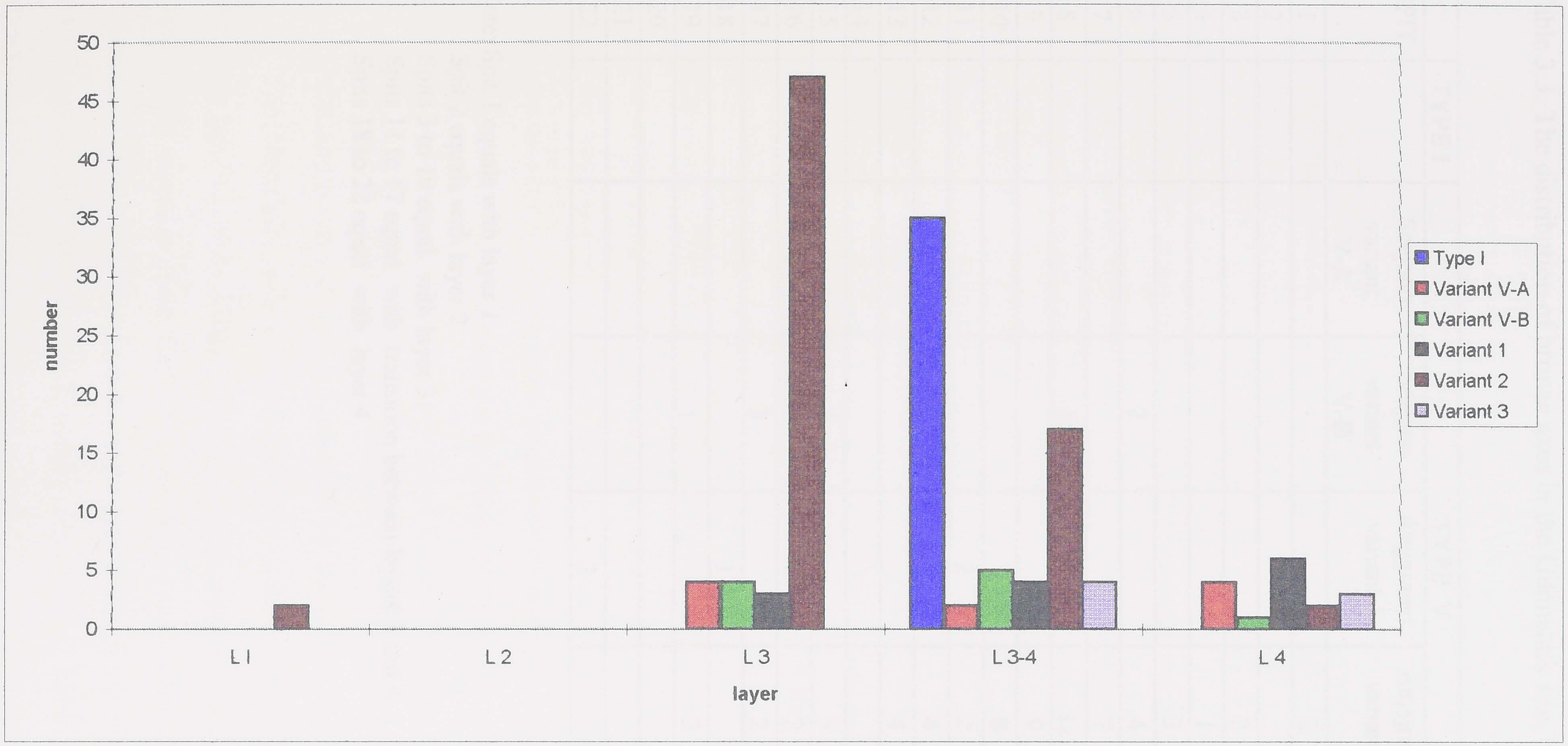


Figure 3.8. Bar chart showing the distribution of bronze axes in the Gilimanuk site, by layer.

Table 3.3. The distribution of bronze axes in the Gilimanuk site, by spit.

	TYPE I	TYPE V				
SPIT		Soejono variant V-A	Soejono variant V-B	Anggraeni variant 1	Anggraeni variant 2	Anggraeni variant 3
1					2	
2						
3					2	
4					1	
5					3	
6			2		4	
7					7	
8			1		12	
9					9	
10					8	
11				2	2	1
12					4	3
13					4	
14						
15			1		3	
16	35	1	1	1	2	
17			3		2	
18				1		
19			1		2	
20						
21						
22				2		

Note: Spit 1 equals with layer 1
Spit 2 equals with layer 2
Spits 3 to 10 equal with layer 3
Spits 11 to 17 equal with transition between layers 3 and 4
Spits 18 to 22 equal with layer 4

Table 3.4. The distribution of bronze axes in the Gilimanuk site, by layer.

	TYPE I	TYPE V				
LAYER		Soejono variant V-A	Soejono variant V-B	Anggraeni variant 1	Anggraeni variant 2	Anggraeni variant 3
L1					2	
L2						
L3		4	4	3	47	
L3-4	35	2	5	4	17	4
L4		4	1	6	2	3

the axis of symmetry and the shoulder cannot be measured because no intact specimens were recovered. However, based on unlabelled intact specimens stored in the National Research Centre of Archaeology, Bali office, it is known that the angles are between 70° and 80°.

Two intact specimens 3.5 cm and 5.2 cm long, and seven fragments of shafts, can be grouped as Soejono variant V-B (see figure 3.10 c). Two other intact axes and sixteen broken specimens have slightly different shapes and sizes of shaft from the Soejono variant V-B, so I group them into Variant 1 in this examination (see figure 3.10 a). The lengths of the Anggraeni variant 1 axes are about 5.8 to 13 cm.

The results of measurement also demonstrate that the average ratio between the widths of the proximal and distal end of socket for the Soejono variant V-B is 2:1, but the Anggraeni variant 1 axes have an average ratio of 3:2. As a consequence, the Anggraeni variant 1 has a more parallel-sided shaft than the former. The angles between the axis of symmetry and the shoulders of the intact specimens of Anggraeni variant 1 and Soejono variant V-B are about 80° and 90°. The thicknesses of blades of both variants are quite close; the Soejono V-B type is between 0.18 cm to 0.32 cm, and the Anggraeni variant 1 is between 0.14 cm to 0.31 cm.

The Anggraeni variant 2, includes eight intact specimens and sixty-four fragments (see figure 3.10 b). This is a miniature of Soejono variant V-B. The maximum length of this variant is about 3 cm, but most are no more than 2.0 cm long, and most of the blades are broken. This is because the join between the distal end and the blade is the weakest part. The socket is usually not obvious, because it is filled in with

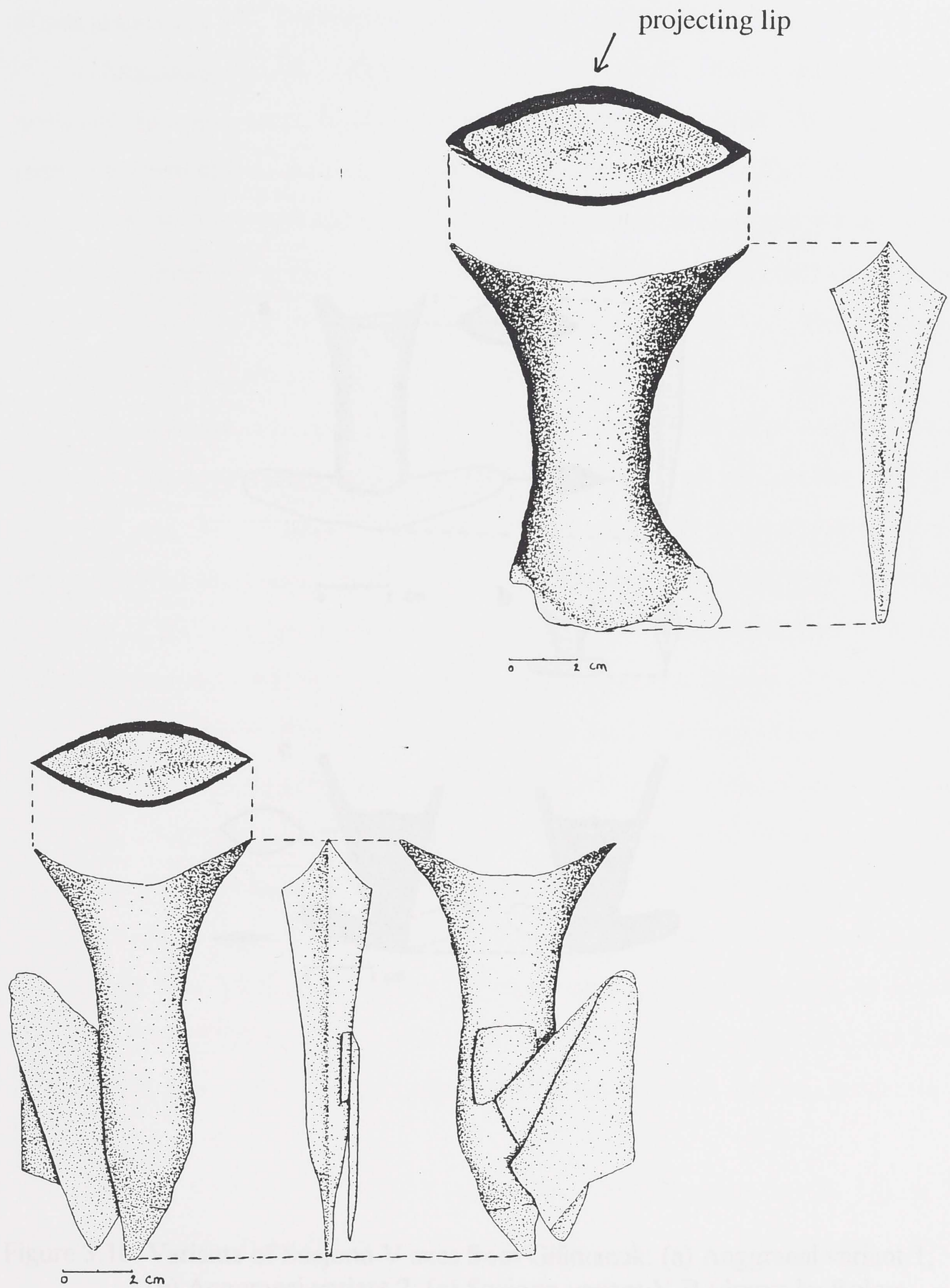


Figure 3.9. Fragments of Soejono variant V-A axes from Gilimanuk (drawn by Sektiadi).

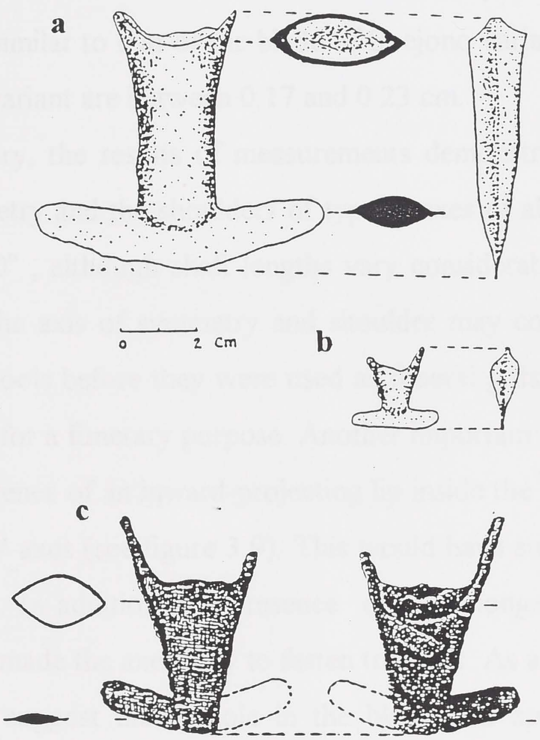


Figure 3.10. Variants of Soejono V axes from Gilimanuk: (a) Anggraeni variant 1; (b) Anggraeni variant 2; (c) Soejono variant V-B (drawn by Rokus Due Awe)

hardened soil. The angles between the axis of symmetry and the shoulder of this kind of axe are around 90°. The thicknesses of the blades are between 0.15 and 0.25 cm.

Anggraeni variant 3 (figure 3.11) includes three almost complete specimens and four fragments. It is characterised by a very short shaft. The length of the shaft, from proximal to the distal end of socket is between 1.0 and 3.0 cm, and ratios between maximum length and width are 2:5. The angles between the axis of symmetry and the shoulders are between 80° and 90°. The shape of the blade of Anggraeni variant 3 is very similar to that of the blade of Soejono variant V-A. The thicknesses of blades of this variant are between 0.17 and 0.23 cm.

In summary, the results of measurements demonstrate that angles between the axis of symmetry and the shoulders of type V axes of all variants are mostly between 80° and 90° , although shaft lengths vary considerably. Particular values of angles between the axis of symmetry and shoulder may correlate with the original functions of the tools before they were used as funeral gifts, unless they were deliberately produced for a funerary purpose. Another important feature of the Gilimanuk axes is the occurrence of an inward-projecting lip inside the tops of the sockets in all variants of type V axes (see figure 3.9). This would have stopped handle from moving at the socket. In addition, the presence of two elongated tips at the proximal ends, most likely made the axes easy to fasten to a haft. As a comparison, Glover and Syme (1993:67) suggest that a hole in the blade that appears in some socketed bronze axes from Vietnam is possibly 'to take a peg to secure' the haft. As a result, these features of the axes, i.e. a hole in the blade of the Vietnamese axes and hooks or elongated tips at the proximal ends of the Gilimanuk axes, may be comparable in function.

Bernet Kempers (1988:293) has noticed an interesting feature among the bronze axe-blades frequently found in Indonesia. This being 'the various types of swallow-tail specimens'. However, I suggest that the term 'swallow tail' needs to be redefined. It is usually used for both the true swallow tail shape, and for the deep concave proximal end of the Anggraeni variants 1 and 2, and Soejono V-B axes. However, the term should not be used for describing the latter group of axes.

In the case of Gilimanuk, it seems that the lengths and shapes of shafts are

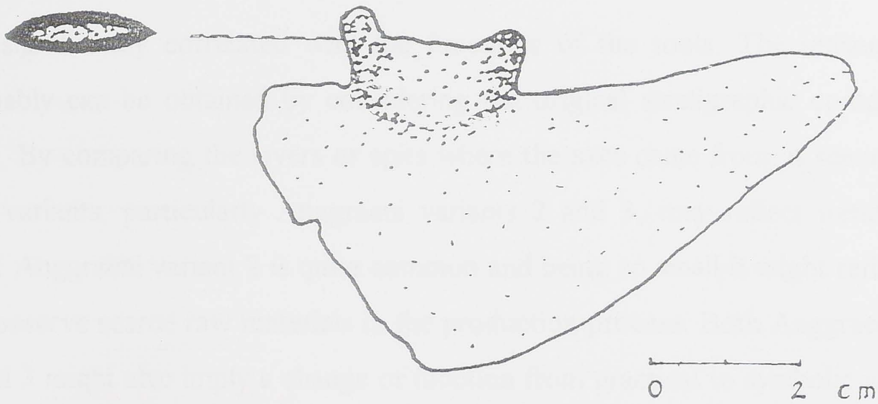


Figure 3.11. A fragment of an Anggraeni variant 3, Soejono type V axe from Gilimanuk.

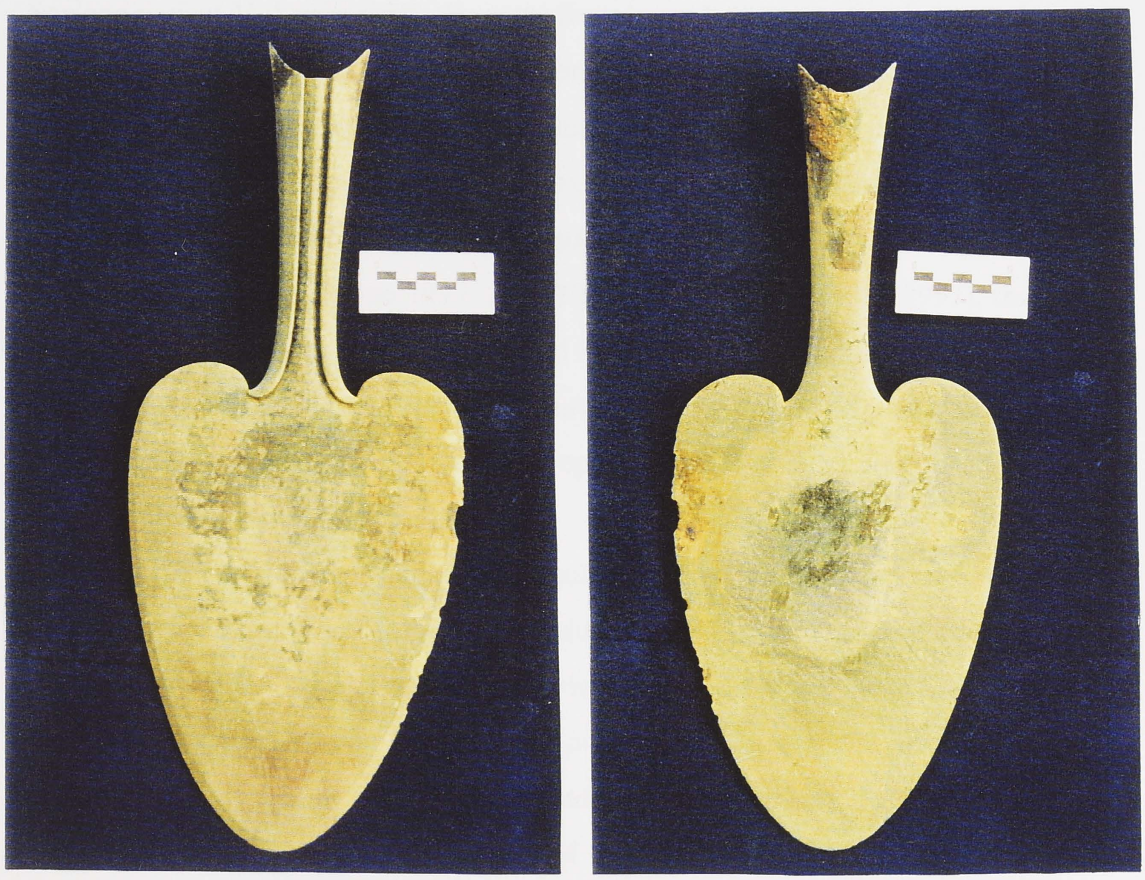


Figure 3.12. An example of Soejono type VI axe from Bali,
showing the first and second sides.

not significantly correlated with the functions of the tools. The reasons for this probably can be obtained by considering the original stratigraphic contexts of the axes. By comparing the layers or spits where the axes came from, it seems that certain variants, particularly Anggraeni variants 2 and 3, may reflect trends through time. Anggraeni variant 2 is quite common and being so small it might reflect a need to conserve scarce raw materials in the production process. Both Anggraeni variants 2 and 3 might also imply a change of function from practical to symbolic usage only. This assumption may be convincing if is supported by valid dating that indicates the period of development of each variant. Fragments of Anggraeni variant 2 were also unearthed from sarcophagus contexts in Bali (see Soejono 1977 plate 70).

The contexts of each variant are interesting to consider. The fragments of Soejono variant V-A axes originally came from layer 3, the transition between layers 3 and 4, and from layer 4. However, only one fragment was clearly associated with a burial, that is skeleton number LXXXI, along with beads, sherds and animal bones (Aziz 1983:29). On the other hand, some excavation reports mention the appearance of bronze axe types that were almost all associated with burials. From the reports and the illustrations (e.g. Soejono 1977; Aziz 1983; Yuliati and Suastika 1993), the majority of the burial axes can be recognised as Soejono variants V-A and V-B, and Soejono type VI (see figure 3.12). Unfortunately, the numbers of each type and the original layers of finding have rarely been reported, but they range from one to seven pieces per burial (see figure 3.13).

In the burial record, all the Gilimanuk type axes, intact or fragmentary, were found with the of burials of forty-six individuals from spits 7 to 17 and 19 to 24 (or layers 3 and 4). The skeletal remains of burial CXXIV, however, were found associated with fragments of two axes and six pottery vessels in spit 2, at only 24 cm depth. Seemingly, sex or age were not significant in determining the numbers or the types of axes for grave goods. Variants of the Soejono V axes, in particular, occurred along with the burials of fifteen individuals; male and female adults (25 to 55 years old), infants (0 to 6 years old) and juveniles (12 to 14 years old). Some of these burials were not only furnished with bronze axes, but also with bronze bracelets, earrings, gold ornaments and other metal objects (table 3.5).

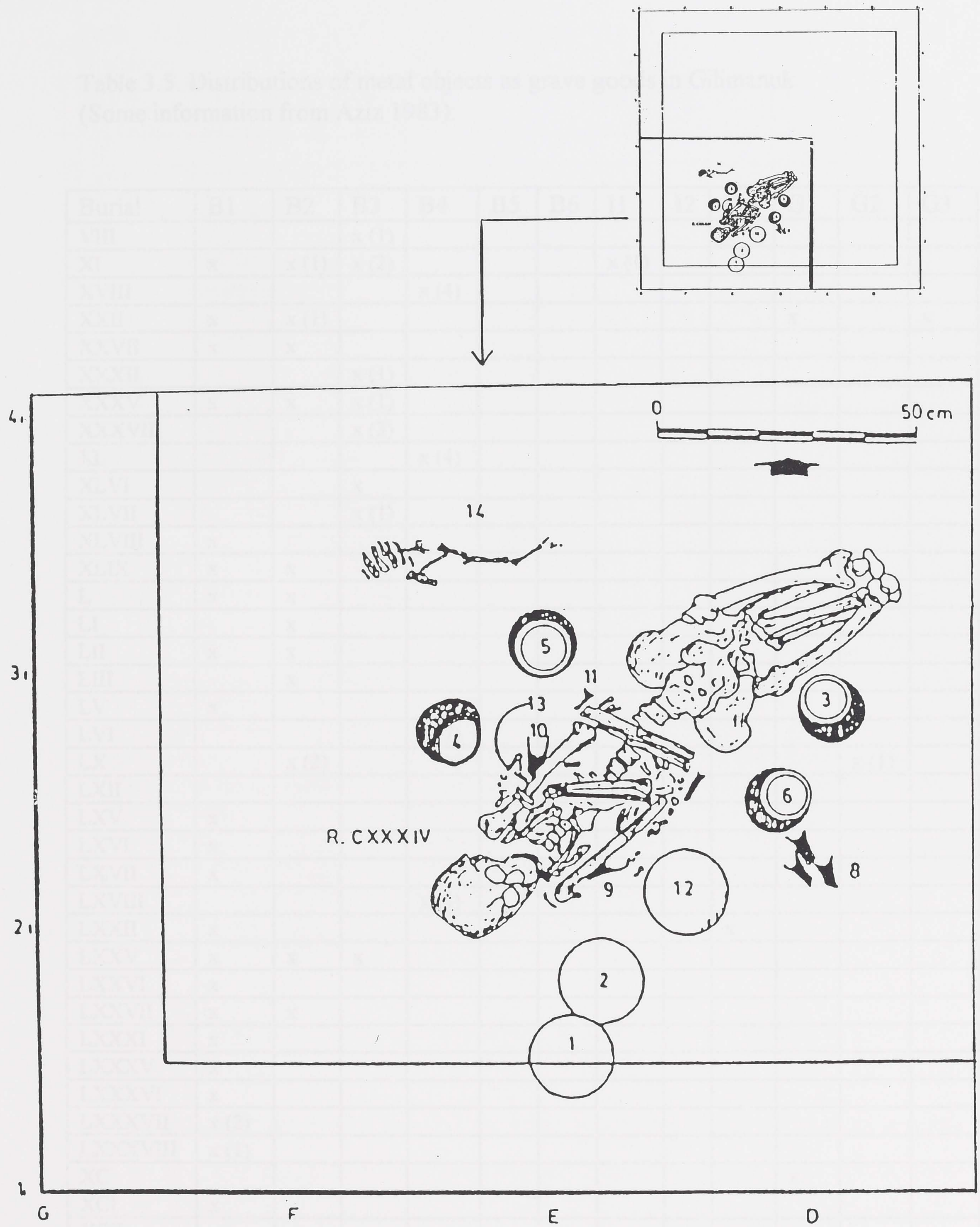


Figure 3.13. Skeleton CXXXIV in spit 17 of square S.XLVIII, with funerary gifts: (1-2, 12-13) pottery dishes; (3-6) cooking pots; (7-11) fragments of bronze axes; (14) skeletal remains of a fowl. (from Yuliati and Suastika 1993).

Table 3.5. Distributions of metal objects as grave goods in Gilimanuk. (Some information from Aziz 1983).

Burial	B1	B2	B3	B4	B5	B6	I1	I2	I3	G1	G2	G3	G4
VIII			x (1)										
XI	x	x (1)	x (2)				x (1)						
XVIII				x (4)									
XXII	x	x (1)								x		x	
XXVII	x	x											
XXXII			x (1)										
XXXV	x	x	x (1)										
XXXVIII			x (3)										
XL				x (4)									
XLVI			x										
XLVII			x (1)										
XLVIII	x												
XLIX	x	x											
L	x	x											
LI		x											
LII	x	x											
LIII		x											
LV	x												
LVI				x (7)									
LX		x (2)									x (1)		
LXII							x						
LXV	x												
LXVI	x												
LXVII	x												
LXVIII				x (4)									
LXXII	x								x				
LXXV	x	x	x										
LXXVI	x												
LXXVII	x	x											
LXXXI	x												
LXXXV	x												
LXXXVI	x												
LXXXVII	x (2)												
LXXXVIII	x (1)												
XC										x			
XCI	x												
XCII	x	x							x				
XCIV													
XCV	x												
XCVI	x												
XCVII-a	x (4)												
C	x												
CI	x												
CII	x												x
CIII						x							

Table 3.5
continued

Burial	B1	B2	B3	B4	B5	B6	I1	I2	I3	G1	G2	G3	G4
CIV	x												
CIX	x				x								
CXIII													
CXIV					x		x (1)	x			x (1)	x	
CXV	x												
CXIX	x (35)												
CXXI	x (6)												
CXXII	x												
CXXIV	x												
CXXIX				x (6)									
CXXXIII	x												
CXXXIV	x (7)												
CXXXV	x												
1	x	x											
2	x												
3	x	x											
4	x												
5	x												
6	x												
7											x (1)		
8												x (2)	

Note:
B1 Bronze axes; B2 Bronze bracelet; B3 Bronze earring/ring;
B4 Bronze pentagonal plate; B5 Bronze fishhook; B6 Decorated-sheet bronze;
I1 Iron spearhead; I2 Iron knife; I3 Other iron objects;
G1 Gold beads; G2 Eye and mouth cover of gold-like metal;
G3 Gold cone-shape ornament; G4 Other gold ornament.
1-8 : additional skeletons from squares S.XXI, S.XXII, S.XXXIV, S.XXXV, S.XXXVI, S.XXXIX.
x (..): present (numbers in brackets)

One Soejono variant V-B axe found in spit 15 of square S.XXII, approximately 10 cm above the skeleton of a child, still retained traces of a fine textile wrapping on both sides. This axe, 3.7 cm long, was wrapped in two kinds of textiles, that on one side being finer than on the other side. Rokus Due Awe (1998, pers. comm.) from the ArchaeometrySection of the National Research Centre of Archaeology, Jakarta, who help me to identify the material, suggests that the fibers, 1-2 mm wide, were probably of rattan and *Pandanus sp*. In addition to the wrapped axe, fragments of two bronze axes and five blades found in layer 4 of square S.XIII, and a fragment of an axe blade from layer 4 of square S.XVII, showed remains of wood fibers on their surfaces. Those findings were recovered in the 1964 excavations, but have not been identified yet. My own examinations indicate that some metal tools or weapons from Gilimanuk were placed directly in wooden scabbards, or after being wrapped in fine cloth and then a coarse outer wrap.

It should also be noted that Anggraeni variants 1, 2, and 3 discussed above are different from the sub-types proposed by Aziz (1983; see figure 2.4), these being sub-types V-B1, sub-type V-B2 and their variants. Unfortunately, the Aziz (1983:113) specimens, which were stored in the National Research Centre of Archaeology in Jakarta, cannot be located, so that they cannot be examined and compared with the three Anggraeni variants proposed above. However, based on her illustration, Aziz subtype V-B2 was seemingly a fragment of a bronze axe of Anggraeni variant 2 that had lost its blade, as it was broken exactly at the join between blade and shaft. A long process of corrosion may cause the breakage scars to become eroded away, so that such a fragment can look like a different intact object. In addition, my observations on fragments of axes revealed that the tips of proximal ends have always broken off.

Incomplete records and documentation have necessitated the careful rechecking of the specimens carried out by me for this thesis. A socketed axe stored unlabelled in the National Research Centre of Archaeology in Jakarta, for example, has not been included in my examination. This is because the origin of the axe is uncertain, although a duplicate displayed in the Gilimanuk Museum is labeled as from the 1964 excavation. Moreover, Soejono (1977:11-2, figure 148, plate 130-2) reported that such an axe was found in a sarcophagus in the Keramas site, but not at Gilimanuk. Two big axes of Soejono types VI stored in the National Research Centre of Archaeology, Bali office also cannot be included in the examination as they are stored without labels.

GILIMANUK IRON AND GOLD ARTEFACTS

The iron specimens discussed here have been examined direct and indirectly from some references. They are composed of one iron spearhead and another iron spearhead with a socket bronze haft from the 1984/1985 excavation (see figure 3.14), fragments of iron blades probably from knives, a hoe and unidentified fragments. As was mentioned in the previous chapter, Soejono (1979:193) also found an iron spearhead with a bronze sleeve. This sleeve, 4.4 cm long and 3 cm width, was constructed from two bronze plates, 0.38 cm and 0.29 cm thick, forming an oval hole (see figure 3.15). The sleeve packed with hardened soil-type matrix into which the tang of the iron spearhead was set. This bronze sleeve was recovered together with the iron spearhead in the third layer of square S.XIII. Based on examination of complete items and the shapes of fragments, I assume that ordinary iron objects without bronze sleeves from Gilimanuk had long narrow circular or rectangular-sectioned pointed tangs which might be inserted into wooden shafts. While the iron hoe, 13.29 cm long and 4.22 cm wide, was found in spit 6 of square S.XXXI. This tool has a fan-shaped working edge and straight shaft (see figure 3.16).

Terms used in naming iron tools or weapons in Indonesia are still confusing, as there is no published definition for each type. Four iron artefacts identified as two spearheads and two daggers by Soejono (1977, plate 167), seem to me all to be spearheads. They have thin long blades with lenticular cross-sections, pointed tips and tanged ends. The existence of remain of wooden scabbards and hafts on two of those specimens might have cause they look different to Soejono (1977:182; 1979:193).

Only one of the four iron spearheads can now be located and examined directly. This weapon, 27.5 cm long (including the shaft), 5.5 cm wide and 1.73 cm thick, was found associated with the burial LXII in square S.XIII. Remains of two overlaid layers of woven fiber wrapping can be seen on the shaft of the spearhead, and remains of a wood scabbard survive on both surfaces up to the shaft (see figure 3.17). My examination indicates that the outer wrapping is composed of coarse woven fibers, while the inner is fine. These woven fibers look different from textile wrapping on the Soejono variant V-B bronze axe mentioned above (see page 82). Awe (1998, pers.comm.) suggests that the coarse fibers could be from rattan or *Pandanus sp.*, while the fine ones might be of *Ficus sp.* or *Hibiscus sp.*

The gold-like metal specimens from Gilimanuk can only be examined

Figure 3.14. Burial CXIV from Gilimanuk, with a number of funerary gifts (listed in page 88).
(Courtesy: National Research Centre of Archaeology, Jakarta)

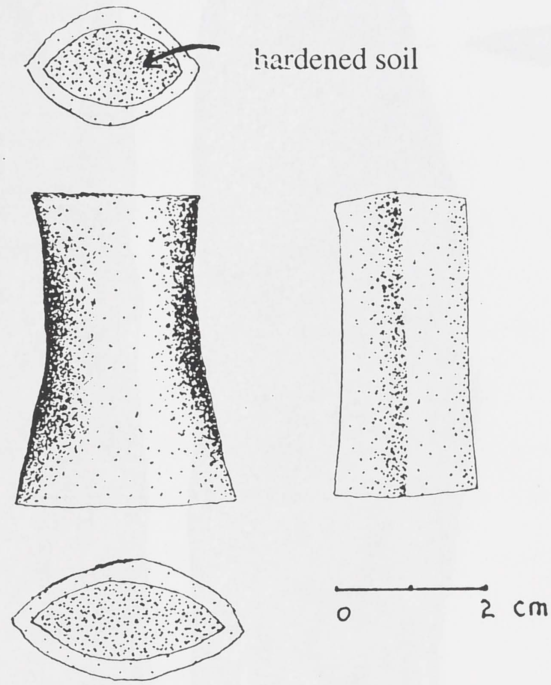


Figure 3.15. A bronze sleeve for an iron spearhead from Gilimanuk (drawn by Sektiadi).

Figure 3.16. An iron hoe from Gilimanuk.

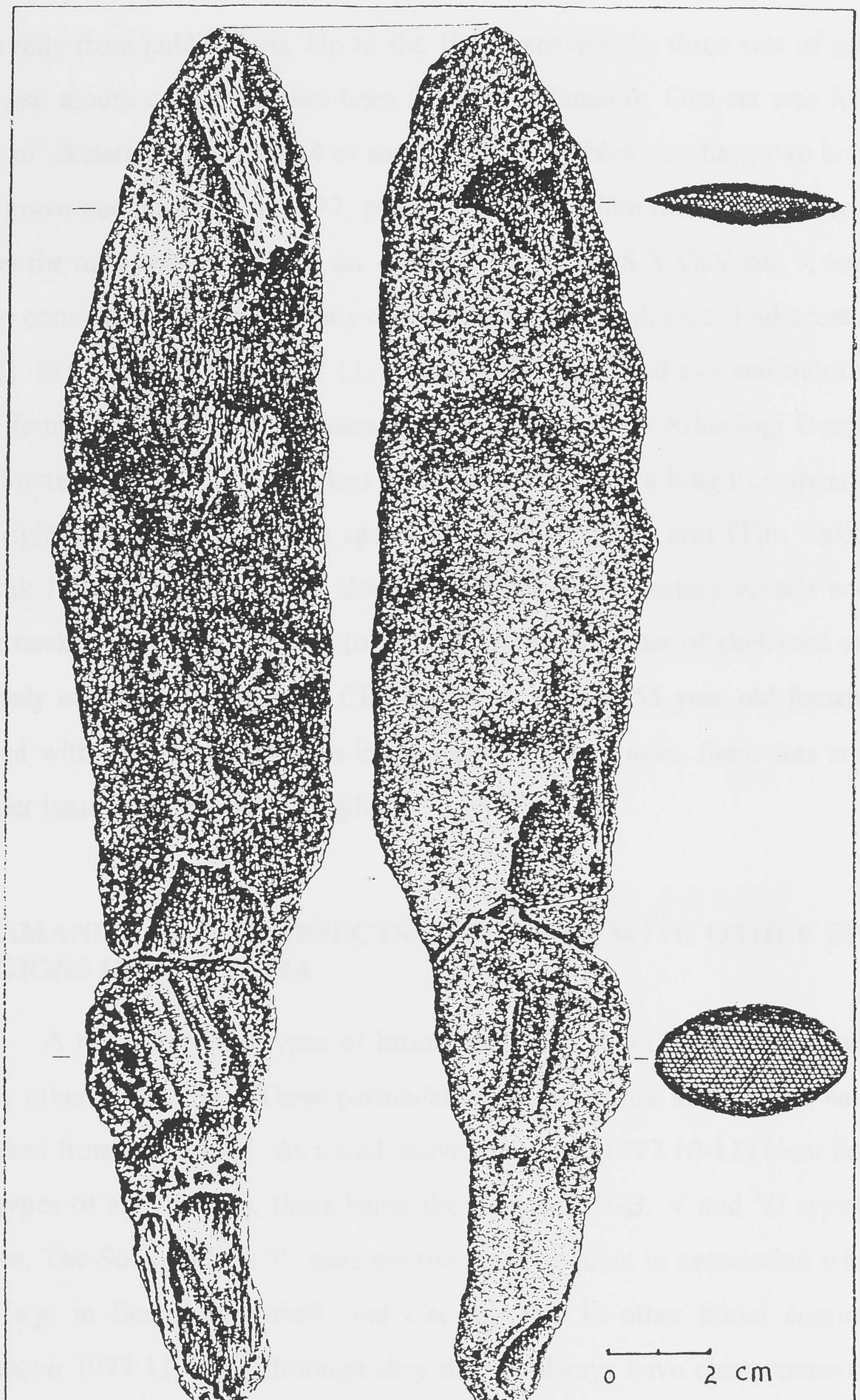


Figure 3.17. An iron spearhead from Gilimanuk, with remains of a wooden scabbard and two kinds of wrapping.
(drawn by Rokus Due Awe).

indirectly from publications. Up to the 1997 excavations, three sets of gold-like foil eye and mouth coverings have been found in Gilimanuk. One set was found on the face of skeleton LX in layer 4 of square S.XVIII which also have two bronze bracelets grave goods (Soejono 1977, plate 150). A gold-like foil eye cover continuing to cover the nose was discovered on a skull from square S.XXXV spit 9, together with three cone-shape gold ornaments on another human skull placed adjacent (see figure 3.18). In square S.XXXV spit 11, another set of gold foil eye and mouth coverings was found on the face of skeleton number CXIV (Balai Arkeologi Denpasar 1985; see figure 3.19). Burial CXIV was also accompanied by a long iron spearhead above the right arm and a bimetallic spearhead above the left arm (Tim Ekskavasi Gilimanuk 1985; see figure 3.14), along with fragmentary pottery vessels and an intact long necked pottery flask. Due to the limitation in number of skeletons analysed, so far only one skeleton (number CII) known as a 50 to 55 year old female, was furnished with gold ornaments. As in the case of bronze axes, there was seemingly no gender issue in giving funerary gifts.

GILIMANUK METAL OBJECTS COMPARED WITH OTHER SITES AND REGIONS IN INDONESIA

A number of the types of bronze objects known in Gilimanuk are occur in many other sites in Bali. These particularly include bronze axes, which have been recovered from sarcophagi. As noted above, Soejono (1977:10-11) identified three local types of axes in Bali; these being the Soejono IV-B, V and VI types discussed above. The Soejono type V axes are the most frequent in association with sarcophagi (e.g. in Beng, Tamanbali, and Cacang) and in other burial contexts in Bali (Soejono 1977:11, 28). Although they do not always have clear contexts, Mardika (1990) has also noted the occurrence of such axes in Marga Tengah, Bukian, Laplapan, Cacang, Timbul, Klusu, Taman Bali, Keramas, Tohpati and Gilimanuk. The Marga Tengah specimens (see Soejono 1977, photo 70) are equal in shape and size to the Anggraeni variant 2 axes from Gilimanuk.

Soejono (1977:58) suggested that seven axes found in a sarcophagus at Cacang probably broke before burial. Soejono (1977:11) also claimed that, compared

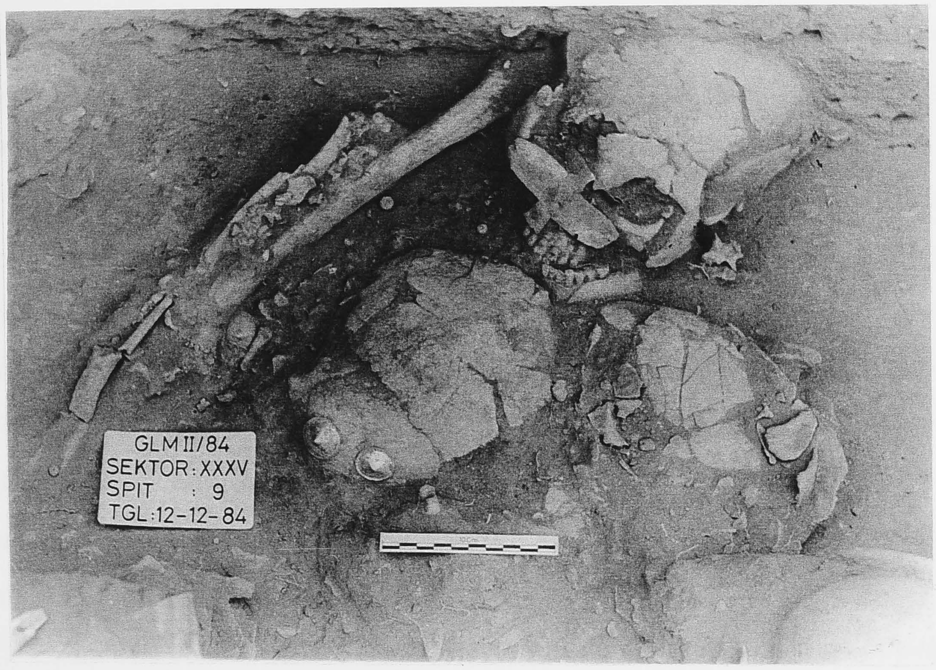


Figure 3.18. A gold-like foil eye cover and cone-shape ornaments placed on adjacent skulls in square S.XXXV of Gilimanuk.
(Courtesy: National Research Centre of Archaeology, Jakarta)

Figure 3.19. Gold-like foil eye and mouth covers on burial CXIV, square S.XXXV.
(Courtesy: National Research Centre of Archaeology, Jakarta)

to the Soejono type V, the Soejono IV-B axes have stronger and thicker blades, so they are more likely to have had practical functions. This type, however, has not been found in Gilimanuk.

In addition to the types mentioned, Soejono (1977:11-2) also reported the occurrence of three other types of axe in Bali. The first is a distinctive type found in a sarcophagus in the Keramas site (Soejono 1977:11-2, photo 130). The second and third types, with fan-shaped blades, belong to Soejono types I and II (Soejono 1977:12). Common in other Indonesian regions, only a few of these have been found in Bali, and all from unknown contexts (Soejono 1977:12; Mardika 1990). So, as mentioned above, it is interesting that parts of 35 Soejono type I axes have been found associated with one burial in Gilimanuk.

Another bronze item claimed as a local Balinese type is the sets of pentagonal plates. As well as in Gilimanuk, a set of four thin pentagonal plates was found inside a sarcophagus in Tigawasa (Soejono 1977:17). Similar objects were also found in other sites in Bali, from inside sarcophagi that have been disturbed by villagers (Soejono 1977:17). Bronze personal ornaments (e.g. arm and leg bracelets, earrings), fragments of bronze spirals and Indonesia kettledrums of the Pejeng type are widely distributed in Bali, but none of Heger I type have yet been reported (Ardika 1991:131). So far, the decorated bronze pieces from Gilimanuk, that I suppose to be fragments of a bronze drum, are still difficult to identify with certainty as fragments of either Heger or Pejeng type. This is because the rows of triangle decoration appear on both types.

Certain types of gold and iron objects, especially from sarcophagus contexts, also demonstrate similarities with those from Gilimanuk. Gold beads were recovered at Marga Tengah and Sembiran, while cone-shape gold artefacts and gold foil eye covers were also found at Pangkungliplip (Soejono 1977:44-5). Iron spearheads were found inside sarcophagi at Nongan and Pangkungliplip. In summary, almost all types of metal objects associated with the widespread sarcophagi have also been found in Gilimanuk. This is not only reflected in the metal artefacts, but also in the use of burial containers in Gilimanuk (especially stone sarcophagi), the presence of glass beads and the various shapes of plain and decorated pottery. But while net-impressed decorated sherds are common in Gilimanuk, Soejono (1977:45) mentioned that they have only otherwise been found in the sarcophagus of Tamanbali A, and only small numbers of glass beads have been recovered from sarcophagi (being very small, perhaps most have been lost).

It is also important to note that the textile and wooden scabbards on some of the bronze and iron tools from Gilimanuk have never been reported in other sites in Bali. Some questions which emerge are as follows. What was the role of Gilimanuk in the Early Metal Phase? Did it serve as an inter-island trading harbour for obtaining exotic raw materials? The problem here is, there are still insufficient absolute dates to trace the spread of metallurgy in Bali. The other question is why are bronze axes so rarely found intact in Gilimanuk and in the Balinese sarcophagi? Were they deliberately broken? The answer to this is uncertain. Tanudirjo (1998 pers. comm.) informs me that among the Chinese community, broken objects were often the favourite objects belonging to a deceased; even if not in good condition they would be utilised as funerary gifts.

To some extent, metal items from Early Metal Phase sites outside Bali are also comparable to those of Gilimanuk. This, for example, is demonstrated by the appearance of a similar tradition in wrapping iron weapons. As was mentioned in Chapter 2, remains of woven fiber covering can still be seen on one surface of an iron hoe and a bronze axe, and on both surfaces of an iron spearhead, from Pasir Angin in Java (Tim Peneliti Arkeometri 1992). The spearhead also retained a kind of textile above the woven fiber, while another iron spearhead retained the remains of a wood scabbard (Tim Peneliti Arkeometri 1992). Although the type of fiber and the sizes of the woven fiber are different, these wrapped tools and the use of wooden covering remind us of similar finds from Gilimanuk. It is interesting to note that bronze sleeves on iron spearheads also appeared in both Pasir Angin and Gilimanuk. On the other hand, types of bronze axes in each site show differences that may reflect separate development. Both issues will be clarified in the next chapter by observing the development of metallurgy in mainland Southeast Asia.

As in Gilimanuk, many metal objects from Early Metal Phase sites in Indonesia have been recovered in association with burials. Some of those found outside burial contexts indicate aspects of local subsistence, for instance the fishhooks found in several coastal sites, including Gilimanuk, Plawangan and Sembiran.

In both Gilimanuk and Plawangan, metal items were not restricted as grave goods to only certain ages or sexes. This can be shown by the use of a bronze kettledrum for burying a child in Plawangan. The exceptional nature of this burial was not only in the use of the kettledrum, but also in the existence of gold-like foil eye and mouth covers inside the drum. Comparable to the skeleton of an adult found under a double jar burial in Gilimanuk, the skeleton of another child buried under the kettledrum in Plawangan might also have been meant as a funerary sacrifice. In this case, certain metal artefacts such as kettledrums and gold-like foil eye and mouth covers were quite possibly related to high social rank.

Separate from burials, fragments of iron objects were frequently recovered from top to bottom of excavation squares in Plawangan, together with sherds, shells, bones and beads. There were differences in the range of Gilimanuk and Plawangan iron tools. The Gilimanuk iron tools from non burial contexts, most from layer 3, consisted only of a hoe and unidentified fragments. The Plawangan iron assemblage, however, was dominated by iron knives, with several fragments of iron fishhooks.

In addition, the appearance of brass objects in both Plawangan and Gilimanuk is interesting. They were found not only in the first spit of square XV, but also in spit 7 of square VI in Plawangan (Prasetyo 1987:14). The existence of an inscription on one of the Plawangan objects clearly indicates the later use of the site. However, in the case of Gilimanuk, the occurrence of a brass earring in layer 4, with a burial, is surprising. Was the manufacture of brass introduced into Indonesia as much as 2000 years ago? This issue will be discussed in the next chapter.

Prasetyo (1987:11) suggested that among the iron and bronze objects at Plawangan there were many nails. However, I think some of these items are more likely to be tangs for iron tools (e.g. knives, daggers, etc.), which usually are inserted into shafts of wood or other material. In fact, Prasetyo (1987:17) makes the same suggestion for the complete iron chisels, that the long circular tangs may be inserted into shafts, but he prefers to include all other such fragments under 'points' or 'fragments of nails'.

So far, the evidence available suggests that Gilimanuk and Plawangan shared a similar material culture (of metal artefacts, jar burials, glass beads, and pottery), but they might have belonged to different stages in the development of metallurgy. The absence of bronze axes in the Plawangan site may relate to a later stage then Gilimanuk when iron tools were more common.

METALWORKING-RELATED ARTEFACTS

Among the Gilimanuk metal specimens, two fragments of axes, that is an Anggraeni variant 2 and a Soejono variant V-A, were still encased in an unidentified matrix softer than baked clay, about 2 to 7 mm thick. Both were found in spit 16 of square S.XXII, together with a fragment of a shaft of an Anggraeni variant 1 bronze axe. The latter was found close to the skeleton of a child, but there is no information about any burial association from the first two fragments. In addition, lumps of baked clay also occur in spits 6 and 12 of square S.XXIV (Indraningsih 1977:31), the latter found in association with a burial. It is quite possible that the baked clay lumps in spit 12 were not *in situ*, but were intruded with grave fill. However, these finds are still difficult to indicate the occurrence of bronzeworking above the burial layer, especially by using lost wax techniques.

As a comparison, A.C. Kruyt (1938, cited in Heekeren 1958:6) has reported that lost wax casting methods were still applied until early 20th century in central Sulawesi for making 'little bronze bells, axes, spear-heads, bracelets for arm and leg, and also small figurines and buffaloes'. In the case of Gilimanuk, whether that technique does occur or not, need more supporting evidence as axes are easier to make by using bivalve moulds.

Small amounts of iron slag were found scattered in some squares in Gilimanuk, such as S.XX, S.XXI, S.XXIV, S.XXVII, S.XXXIV, S.XXXV, and S.XLIII. Those squares, however, may have been disturbed by burials. In square S.XX, for example, fragments of human bones and teeth were found from spit 15 to 17. A piece of iron slag was found in spit 16 and other fragments of bronze and iron objects were more frequently found in upper layers, up to spit 4. However, intact skeletons of five individuals with grave goods, such as a fowl, pots and beads found in spit 18 to 21, have only accompanied by a stick-shape small fragment of a bronze object. The spread of finds clearly indicates that the layers above the intact burial have been disturbed. Three other pieces of iron slag, meanwhile, were recovered apart; in spit 10 of squares S.XXI and S.XXXIV, and in the third layer of square S.XXXV (Tim Ekskavasi Gilimanuk 1984:9). The existence of iron slag in very small number together with iron scraps may indicate that iron ore smelting were not occurred in Gilimanuk. Iron slag and scraps might be valuable as funerary gifts. The occurrence of a number of iron fragments may indicate scrap usage ironworking, but this still need supporting evidence.

Evidence for bronzeworking in Gilimanuk consists of cupreous slag and small lumps of copper or bronze. Most of this evidence was found in spits 9 and 10, above the main burial layer. Two pieces of bronze slag were recovered in spit 10 in squares S.XXXIV and S.XLIII. Four small lumps of copper or bronze were found respectively in square S.XXII spit 9, two in square S.XXIV spit 10, and one in square S.XXVII spit 10. Horizontally, those features were found quite close together. The small lumps of copper or bronze could be debris of ingots and may suggest that the Gilimanuk inhabitants imported small ingots for casting on site.

It is important to note that some metal items from Gilimanuk, in particular hoes, axes and their variations, indicate bivalve casting. However, durable casting moulds have not so far been found in Gilimanuk. Fragments of baked-clay moulds for making bronze axes have been found outside Bali, i.e. from the Bandung Plateau, the Buni complex and Pejaten in Java, and from the Leang Buidane jar burial deposit in Talaud Islands. However, compared to the Gilimanuk axes types, the Leang Buidane moulds (see Bellwood 1976:419, fig. 3) are obviously different.

In sites on the Bandung Plateau, W.Rothpletz (cited in van Heekeren 1958:6-7) uncovered numerous fragments of clay moulds which were not only used for producing axes and bracelets, but also spearheads. The moulds from Bandung were reportedly found together with numerous obsidian flakes, 'potsherds, polished stone adzes, and iron slag' (see Sutayasa 1979:61). Unfortunately, these remains were collected separately, several times, between 1930 and 1945, by A.C. de Jong, G.H.R.

von Koenigswald, J. Krebs, W. Mohler and W. Rothpletz, without systematic excavation. If these finds were positively recovered in one context, then the appearance of iron slag along with casting moulds, without indication of human burial activities, would obviously be remarkably important. Such finds have never clearly been found together in other Early Metal phase sites in Indonesia.

Several other fragments of baked clay moulds for casting axes or knives, in association with stone adzes and numerous cord-marked potsherds, were recovered during an excavation in Kampung Kramat, Pejaten village, south of Jakarta (Sutayasa 1979:66). Situated in a meander of the Ciliwung River, this site was excavated by Sutayasa in 1974, but no metal artefacts were found (Sutayasa 1979:68). Dating based on samples of charcoal from layer 3 (50-60 cm depth), in association with casting moulds and cord-marked sherds, is 2550 ± 200 BP (ANU 1520) and 1830 ± 250 BP (ANU 1519) (Sutayasa 1979:68). Calibrated dates for these samples are 897 (780) 397 BC and AD 58 (220) 531, respectively. Sutayasa (1979:68) claimed that 'these are the earliest absolute dates for copper or bronze casting from Indonesia so far'.

In the Buni complex, northern coast of west Java, human skeletons from disturbed contexts were reportedly found associated with a number of funerary gifts, such as 'stone adzes, pottery, gold ornaments, terracotta net-sinkers, metal objects, mould for casting copper or bronze axes' (Sutayasa 1979:71). In addition, fragments of Indian Rouletted ware were recovered from sites in the Buni complex, relatively close to the location of the finding of the oldest Sanskrit inscription in Java, Prasasti Tugu. These finds, as has been suggested by Bellwood (1997:292-3) are 'directly relevant to the initial period of contact between India and Java, presumably in the first few centuries AD'.

In contrast to Gilimanuk and Pasir Angin, a huge amount of iron slag was recovered in Plawangan. However, other indications of metalworking activities have never been revealed there. Prasetyo (1994/5:14; 1987:30) claimed that the quantity of iron slag rises in the burial layer, although the largest quantity is in spit 6. In this case, clearer explanations might be obtained by considering the deposition process. One alternative, as has been suggested for Gilimanuk, is that the occurrence of iron slag in the burial layers may relate to its accidental inclusion in grave fill. Interestingly, however, a number of pieces of iron slag also appeared along with charcoal, as in layers 2 and 3 in square VIII and test pit VIII, and fragments of iron objects were recovered in layer 3. Therefore, I propose that the appearance of iron slag together with indications of burning might be important for tracing the existence of metal-working activities. This suggestion is supported by the fact that indications of inhumation were not present in these squares.

CHAPTER 4

THE INTRODUCTION OF METALLURGY INTO INDONESIA AND ITS IMPLICATIONS

Considerable similarities and differences among metal specimens from the Indonesian Early Metal Phase sites have been indicated. The existence of these specimens has been widely accepted as a result of contacts with the mainland of Southeast Asia, especially through trading networks. A further comparison with metal objects and their associations from mainland sites is now necessary in order to recognise the introduced and local characteristics within the Indonesian metallurgical tradition. Discussion in this chapter will cover the development and spread of metallurgy in Southeast Asia, the role of the Indonesian Early Metal coastal sites, and the impact of metallurgical technology on Indonesian society.

EARLY METALLURGY ON THE MAINLAND OF SOUTHEAST ASIA

The dating of the earliest Southeast Asian metallurgy is a subject of debate. White (1988:175) has stated: 'The current consensus on the dating of bronze and iron at least for northeast Thailand is that the bronze appears around 2000 B.C., give or take a couple hundred years'. The date of the appearance of iron is also still in debate, as to whether it is before or after 500 BC (White 1988:175). White (1988:176) has argued that the sophistication shown by bivalve mould casting of socketed artefacts in Southeast Asia 'is unlikely to have appeared spontaneously'. Moreover, Southeast Asia is not separate from neighbouring regions; direct or indirect interaction with China, India and the Near East must have had an effect on technology (see White 1988:179). Therefore, White (1988:176, 179) proposed that Southeast Asian metallurgy, with its distinctive characters, has to be seen as the result of "indigenous innovation" rather than purely an "independent invention".

Copper-based artefacts appear as early as the third millennium BC in northern China, perhaps a little earlier than in Southeast Asia, and both regions clearly express some differences (see White 1988:176, 180). The absence of lost-wax casting in northern China before the sixth century BC, the lack of evidence for hammering and northern China before the sixth century BC, the lack of evidence for hammering and annealing in early Chinese bronze objects, the absence of bronze bangles in second millennium BC China, and the absence of piece mould casting of bronze vessels in Southeast Asia, all support the notion of differences (White 1988:180). In addition, Chinese technology of the Shang Dynasty demonstrates different proportions of tin and lead in bronze alloys than contemporary technology in Southeast Asia (Cheng 1960:157, cited in Bayard 1980:197). In the case of the socketed Chinese *pen*, Bayard (1980:197) noted general similarity with Non Nok Tha axes, but parallels with northern China cannot be seen in the round sockets and flared blades typical of some of the Non Nok Tha axes. Seemingly, the round socket is only apparent in some *yueh* axes of the much later Shu, Pa, and Tien civilisations in southwestern China (Chang 1968:424; von Dewall 1967: Fig. 4, No. 10, cited in Bayard 1980:197-8).

Early Metal Sites in Thailand

Evidence for the development of metallurgy in Thailand comes from the Khorat Plateau and the Chao Phraya Valley sites. The Khorat Plateau sites in northeast Thailand can be grouped into early and later sites. The early sites include Non Nok Tha and the Ban Chiang cultural complex, while later sites are Ban Chiang Hian, Ban Kho Noi and Non Chai.

Higham (1996:7) uses the terms 'Bronze Age' and 'Iron Age' in relation to the development of metallurgy and socio-economic factors in Northeast Thailand. These periods, equivalent to General Periods B and C proposed by Bayard (1984, cited in Higham 1988; Higham 1996), vary in date within different regions. The General Periods were derived based on research at Non Nok Tha (see Bayard 1980; Higham 1988).

Excavated in 1966 and 1968, Non Nok Tha was claimed as having been used for burial and perhaps also occupation in three periods, each with distinctive metal objects (Bayard 1980:191). Bayard (1980:191) claimed that a copper tool was present in the latest level of the earliest period, followed by a number of bronzes in the middle period, and then iron objects appeared in the late period. But later examination by Maddin (cited in White 1988:176), indicated that the "copper tool" probably included tin. Thus the whole sequence has bronze.

Bayard (1980:192) stated that, from the 1966 excavation, one bronze socketed axe and 22 bronze bracelets were recovered, together with sandstone mould fragments and two earthenware crucibles, as grave goods distributed through 88 burials. Bayard (1980:192) assumed that the 'three pairs of sandstone double-valve moulds' were used for casting 'two different types of socketed axe'. Concerning the small lumps of bronze found through the site, Smith (1973 cited in Bayard 1980: 192) suggested that they almost certainly resulted from casting spillage. Bayard (1980: 192, 194, 197) further claimed that the lumps of bronze, the crucibles, and particularly the double-valve moulds of indigenous sandstone and the socketed hafting tools, all clearly indicated the presence of metalworking at Non Nok Tha. Three other axes and six bracelets, along with four crucibles and two pairs of moulds, were found in the 1968 excavation from a total of 132 burials (Bayard 1980: 192).

Apart from Non Nok Tha, evidence of metallurgy in northeast Thailand was also retrieved from sites in the northern Khorat Plateau, especially Ban Chiang, Don Klang, and Ban Na Di. In these sites, the 'metallurgy-related artifacts' consisted of baked clay crucibles, bivalve sandstone moulds, and bronze artefacts such as socketed axes, fishhooks, spearheads or arrowheads, bracelets and bells (Pigott et al. 1992:49). Crucibles and casting debris also occurred at Ban Chiang (Pigott et al. 1992:51), indicating the local practice of casting.

Metal objects of the Early Period of Ban Chiang (ca. the first half of the second millennium BC) indicated the casting of a copper-tin alloy and annealing (Stech and Maddin 1988:165, 168). Two bimetallic spearheads with bronze sockets and iron blades appeared in the Middle Period, ca. 1000-300 BC (Stech and Maddin 1988:166). Burials from the Late Period, ca. 300 BC to AD 200, indicated that iron was more commonly used for making tools and weapons rather than ornaments (Stech and Maddin 1988:166). At the same time, the ornaments, such as bracelets and bells, were made of bronze with a high-tin alloy (Stech and Maddin 1988: 166, 168).

Murowchick (1988:195-6) states that copper ingots from Ban Chiang range in size from 4 to 5 cm in diameter and 1 to 2 cm thick, weighing between 60 and 130 g. Large quantities of *in situ* metal slag have never been found in excavated sites in northeast Thailand, so whether metal smelting actually occurred in these sites is yet to be resolved (Pigott et al. 1992:51). The absence of slag, according to Pigott et al. (1992:51) is probably because 'the Khorat Plateau is heavily alluviated and has very few ore deposits'. Two other possibilities are that smelting activities were carried on outside settlement areas, or the Khorat Plateau villagers traveled to mining sites such as Phu Lon, and smelted ores there (Pigott et al. 1992:51). White (1988:178) states: 'Current evidence does not indicate that ore sources were in close proximity to sites of the Ban Chiang cultural tradition or that smelting took place in sites such as Ban Na Di or Ban Chiang'.

Both Non Nok Tha and Ban Chiang produced bronze objects that exhibit similar characteristics; they were cast from tin-bronze alloy with sockets by using bivalve moulds and showed further working such as annealing and cold-working along their edges (White 1988:176). White (1988:177) suggested that such artefacts 'were functional and not just ceremonial replicas', although they were usually found in burial contexts. Considering that most intact bronze artefacts were uncovered in association with inhumations, Pigott et al. (1992:49) argued that 'interpretation of their nature and function may be limited by this context'. They stated that bronze and iron bracelets were commonly found in burials of children at Ban Chiang (Pigott et al. 1992:49). Stech and Maddin (1988:166) added that bronze bracelets and anklets were numerous in the burials of the Middle Period. Concerning the fact that some of the Ban Chiang bronze weapons were found in fragmentary condition, Pigott et al. (1992:50) suggested that they were seemingly "killed" for a funerary purpose. Such treatment appeared not only in the Middle Period at Ban Chiang, but also in the Early Period (White 1982:24, cited in Pigott et al. 1992:50), as shown by a bronze spearpoint with a bent tip.

It is interesting that remarkable similarities occur between Ban Chiang and Gilimanuk. The existence of bronze sleeves for iron spearheads, the wrapping of iron spearheads, bronze fishhooks, the range of personal ornaments (especially bracelets and anklets), and the socketed bronze axes of Soejono type I, occur in both sites (see figure 3.6 and 4.1). In shape, the Gilimanuk bronze axes of Soejono type I are identical to those from Ban Chiang (see Archaeology Division 1991:174). Furthermore, the occurrence of broken axes in Gilimanuk and a bent spearpoint or fragmentary bronze weapons in a Ban Chiang burial context may indicate that damaged artefacts were possibly put in the graves on purpose. In addition to metal objects, clay figurines were also present in both sites. Outside Gilimanuk, a bronze sleeve for an iron spearhead and metal artefacts wrapped in woven fiber also appeared at Pasir Angin. Such evidence clearly shows the echo of Early Metal Phase activities in the mainland of Southeast Asia.

Figure 4.1. Ban Chiang socketed bronze axes of Bangkok National Museum. (from Archaeology Division 1991:174)

Like the occurrence of a brass earring at Gilimanuk, a brass ring was also found in Ban Chiang. According to Stech and Maddin (1988:168) this was most likely 'the accidental result of smelting ore with zinc minerals included perhaps in the attempt to add lead'. These unusual occurrences trigger a question - how did this peculiarity appear twice in similar objects found so far apart? Whether the zinc was added on purpose or by chance is still uncertain.

Higham (1988:132) suggested that although it was mainly used for burials, Level 7 (ca. 900 to 500 BC) of Ban Na Di actually included a facility for bronze working, that is 'a series of clay blocks disposed around a central hollow full of large pieces of charcoal', approximately 60-75 cm in diameter. He added that tuyères might have been admitted by a channel which appeared through the external wall (Higham 1988:132). Lots of fragments of crucibles and bronze were found inside two lenses of dense charcoal staining, at the left and right of the hearth (Higham 1988:132).

Both sandstone and clay moulds were recovered in Ban Na Di. Two fragments of bivalve stone moulds for casting two projectile points and an axe were found in Levels 7 and 6 (Higham 1988:133). Clay moulds were mostly recovered from Level 5; one of them has a decorative design in the inner part, and rice husks used as temper were abundant within the clay layer coat of its inner wall (Higham 1988:133). Lost wax techniques also occurred in Ban Na Di, indicated by, for example, a clay core with remains of wax (Higham 1988:134).

Evidence for bronze casting, however, was particularly found in Level 5, dated to ca. 100 BC to AD 200, and it continued to Level 4, dated after AD 200, together with the appearance of 'jar burials containing the inhumed remains of infants in association with both bronze and iron' (Higham 1988:132). Eight other furnaces found in an area about 45 square meters wide in Level 5 showed differences in size and structure (Higham 1988:132-3). Those furnaces were arranged by putting 'loosely packed blocks of clay' within shallow holes (Higham 1988:133). The majority of them were small, 30 cm by 40 cm, and each was surrounded by fragments of crucibles, moulds, bronze spots, and associated charcoal (Higham 1988:132-3).

Melting bronze by using crucibles was more apparent than smelting in Ban Na Di between 1200 BC and AD 200 (Higham 1988:134). Higham (1988:134) suggested that the Ban Na Di inhabitants acquired bronze alloy by exchange. The alloy was melted and cast into certain objects, such as bracelets, comma-shape beads, bells, fishhooks, and projectile points, as were found in Levels 8 to 4 (Higham 1988:134). Small bronze rings, decorated bells, different varieties of bracelets, and bowls were recovered in the upper layers, Levels 5 and 4 (Higham 1988:135, 137).

Rajpitak and Seeley (1984 cited in Higham 1988:135) stated that four main alloys had been used to produced bronze artefacts at Ban Na Di. The four alloys are: (1) low-tin bronze with between 2% and 14% of tin, represented by a number of bracelets and all the arrowheads analysed; (2) a lead-bronze found in a comma-shaped bead and two fragments of bracelets; (3) a leaded tin bronze found in twenty-five bracelets or rings; (4) a high-tin bronze, with approximately 24 % of tin, present in three to five artefacts analysed (Higham 1988:135). In addition, a bronze wire used to fasten a broken T-shaped cross section stone bracelets has been assumed to consist of a ternary alloy of copper, tin and arsenic (Higham 1988:135-6, 138; Higham 1996:201). Clay figurines of cattle, deer, humans and an elephant were also found in these contexts (Higham 1996:201).

In addition to the bronze objects, fragments of iron which first appeared in Level 7 tended to increase in the later levels and were much more frequent in Level 4 in association with urn burials (Higham 1988:136-7). Considering the appearance of iron slag in Levels 5 to 3, Higham (1988: 136-7) assumed that iron ores were smelted at this site. In the last phase of the early mortuary period, that is phase 1c in Level 7, fragments of iron funeral gifts were recovered (Higham 1988:136). They consist of four circlets, possibly neck rings, an iron coil, a bracelet, and a tanged knife (Higham 1988:136). While White (1988:178) argued that none of the Ban Na Di bronze tools were socketed, a socketed iron hoe or digging stick was found in Level 4 (see Higham 1988:137).

White and Pigott (1996:155) argued that 'the differential distribution of evidence for casting bivalve socketed implements' may have related to the accessibility of sandstone sources for making moulds in the northeastern sites. This situation might have meant that casting activity was more concentrated on bangles, as apparently demonstrated in many of the BCCT sites (White 1988; White and Pigott 1996:155). For such artefacts, a lost wax technique was most likely applied (White and Pigott 1996:155).

The occupation of the Khorat Plateau was extended by the end of General Period B, to even wider areas such as the Songkhram, Chi and Mun river valleys (see Higham 1988:147). Sites in those valleys, such as Ban Chiang Hian, Ban Kho Noi and Non Chai, were much more extensive than earlier sites (Higham 1988:148). Covering more than 18 ha of floodplain, the occupation of the Non Chai site was divided into five phases, from ca. 300 BC to ca. AD 250, and yielded indications of metal working such as iron slag, clay moulds 'for casting bronze bracelets and bells', crucibles and fragments of bronze objects (Higham 1988:148-9). Imported items such as beads, were also found in this site (Higham 1988:148-9). In term of site size, Ban Chiang Hian covered a wider area, about 38 ha, and revealed iron and water buffalo (Higham 1988:148). Higham (1988:148-9) suggested that the large size of the occupation areas indicated by the broad earthworks at Ban Chiang Hian, including 'a double set of moats, a reservoir, and possibly the remains of ramparts', represented 'the existence of centralized chiefdoms' and 'the earlier system of village autonomy'.

Considering the amount and the variety of funeral gifts at Non Nok Tha, Bayard (1980:195) proposed that three classes (poor, wealthy, very wealthy) can be determined, but bronze articles and artefacts from metalworking contexts 'are almost entirely limited to the wealthy burials'. White (1982:48; cited in Pigott et al. 1992:49), however, argued that evidence for tracing a correlation between metal objects as funeral gifts and 'elite social status or an elite group' is limited. Compared to Chinese social stratification of the Shang Period, Southeast Asia in the second millennium BC has no evidence for this (White 1988:179). Moreover, evidence from the earlier northeast Thailand burial sites indicated that the demand for metal products was not restricted to and controlled by high social status (White and Pigott 1996:157). Therefore, White and Pigott (1996:157) assumed that a high level of 'societal ranking' had not appeared in Thailand 'before the mid first millennium B.C.'.

It seems that a low degree of social differentiation is more apparent in the Gilimanuk burial contexts, although Aziz (1986) has proposed three classes (modest, semi modest and complex) based on the variability of grave goods. In this case, the danger of bias in giving a value for each item could appear, as things that are less valuable for modern people may have been prestigious for an ancient community. In Plawangan, however, a high level of social hierarchy, as indicated by the appearance of a distinct burial in a bronze kettledrum may have occurred as the result of later influences. This is supported by the domination of iron implements at this site. A similar practice using a Heger I type drum accompanied by a local (Pejeng) type bronze drum has also been discovered at Kradenanrejo, in eastern Java (Higham 1996:302). In addition, White and Pigott (1996:157) have argued that while evidence of chiefdoms is absent, the grave assemblages of northeastern Thailand implied a 'social differentiation' based on 'age, sex, and social and economic roles'. However, such characteristics cannot be indicated in either the Gilimanuk or Plawangan burial sites.

Metal Sources for Khorat Plateau Metalworking

Bayard (1980:194-5) has suggested that metal sources for Non Nok Tha, including copper, lead, tin, chalcopyrite, chalcolite, malachite and azurite, were available within a certain distance, from about 100 to 300 km away. Concerning such distances, Bayard (1980:195) assumed that metal was obtained through trade, 'either in ores or in the smelted metal themselves'. Phu Lon, the copper ore-rich site in the northwest of the Khorat Plateau, has been suggested as a mining area initially from the early second millennium BC and more intensively during the first millennium BC (Natapintu 1988, cited in Pigott et al. 1992:54).

A number of cobble tools used for crushing ore gravel found along with rocks containing copper ore deposits, and 'galleries with rounded configurations' in the upper reaches of the hill of Phu Lon, indicate old mining activities using stone tools (Pigott and Natapintu 1988:157; Pigott et al. 1992:52-4). Two mining areas can be recognised in the Phu Lon complex, the primary being the Lower and Peacock flats, with a secondary mining area in Bunker Hill (Pigott and Natapintu 1988:157). Pigott and Natapintu (1988:159) reported that Bunker Hill exhibited 'malachite-bearing quartz veins close to the surface', accompanied by flakes of quartz, some cord-marked sherds, ore-dressing stones and stone mining tools. Considering the appearance of different indications in 'some mine shafts', Pigott and Natapintu (1988:157) assumed that metal tools had probably been used in the later mining activities.

In addition to the mining areas, Pottery Flat, an open area on the east side of the hill of Phu Lon, yielded crushed ore gravel, stone tools for ore crushing, two mould fragments, and fragments of crucibles, together with charcoal, cord-marked potsherds, 'polished and/or chipped stone adzes', fragments of stone bracelets, baked clay animal figurines, net sinkers and spindle whorls (Pigott et al. 1992:54-5; White and Pigott 1996:153). The fragments of small crucibles, consisting of more than 70 pieces, indicated tempering with rice husks, and some of them bore copper and tin waste (Pigott and Natapintu 1988:158; Pigott et al. 1992:55; White and Pigott 1996:153). All this indicated an ore crushing and processing centre along with bronze tool production, and temporary occupancy activities for exploiting ore, as suggested by stratigraphic analysis (Pigott and Natapintu 1988:158; Pigott et al. 1992:54-5, 57).

The possibility of ore smelting at Phu Lon is not only indicated by the appearance of small crucibles, but also from a lead sulfide inclusion detected by electron microprobe analysis (Pigott et al. 1992:55). Besides, a small amount of slag can be recognised at Pottery Flat (Pigott et al. 1992:55). However, the expectation that copious slag would have been left at smelting areas of the Phu Lon complex, as has been suggested by Pigott et al. (1992:51), was seemingly not borne out. In this case, several alternatives have been offered; Pigott and Natapintu (1988:158) have assumed that little slag would have been produced when 'properly dressed malachite' was being smelted. While White and Pigott (1996:153) also proposed that 'native copper was being melted', Charoenwongsa and Bronson (1988, cited in White and

Pigott 1996:153) suggested that dressed ore was transported to smelting places which were probably close to areas where fuel resources were abundant.

In the case of bronze production, Workman (1972, cited in Pigott et al. 1992:57) reported that tin can be obtained from the interior of Laos. Fragments of a sandstone and a clay mould recovered at Pottery Flat supported the idea that bronzeworking was being carried out, but identifiable metal artefacts were almost absent in the entire Phu Lon complex; so far, only one socketed axe has been uncovered from Ban Noi (see Pigott and Natapintu 1988:158-9). Ban Noi is another ore-dressing area found north of Lower Flat; a smaller quantity of similar findings to those from Pottery Flat were recovered here (Pigott and Natapintu 1988:159). Contemporary with other sites of the Phu Lon complex, Ban Noi was dated to 'the first half of the first millennium B.C.' (Pigott and Natapintu 1988:159).

In contrast to Thailand, very few metalworking-related artefacts have been found in Early Metal Phase sites in Indonesia, either in burial contexts (e.g. in Gilimanuk, Plawangan, Buni, and Leang Buidane), non-burial contexts (i.e. in Sembiran) or with uncertain associations (e.g. in Manuaba, Pasir Angin, Bandung Plateau and Pejaten, Jakarta). Ardika (1991:132) has argued that the occurrence of socketed axe casting moulds in sites such as Pejaten, Leang Buidane, Pusu Lumut cave in Sabah and Tabon Cave in the Philippines suggested that 'metal artifacts were manufactured locally in Island Southeast Asia, rather than imported ready-made from outside'. In this case, metal production and exploitation of metal sources is unlikely to have occurred very soon after the time of the introduction and initial importation of metal implements. The island inhabitants needed experience and time to explore metal resources, although deposits of copper, tin and iron ore are available in Sumatra and Java (Bronson 1992). Consequently, it is reasonable to surmise that they may have used scrap, and perhaps also imported metal ores as ingots. The evidence available is clearly far from satisfying in term of quantity. However, the appearance of Pejeng type drums and pieces of their casting moulds in Bali, supported by recent indications from Tamblingan, suggest that the Balinese were already well trained in producing metal objects.

Remains of metalworking have recently been found in Tamblingan, Bali during survey and excavations. They consist of eight stone vats, a quantity of metal slag and spillage, sherds covered with molten metal, metal ores, black soil mixed with ash and charcoal approximately 60 cm thick, iron and bronze artefacts (the latter including a fragment of an iron tanged object, a ring, a knife grip and a spiral bronze ornament) and fragments of metal objects (Suantika 1993:135). In addition, remains of a stone construction, potsherds, cooking pots, a grinding stone, pottery discs (*gacuk*), a fragment of a clay cock figurine and foreign ceramics have also been reported as appearing in this site (Suantika 1993:135). The existence of metalworking in this site is supported by inscriptions dating from the 10th to 14th century AD that mentioned groups of iron workers in Tamblingan (Suantika 1993). This evidence suggests that metalworking, especially iron working, was well established within a well-organised Hindu chiefdom in Bali as early as the 10th century AD.

White and Pigott (1996:157) suggested that the appearance of production tools for funeral gifts, for example at Non Nok Tha, indicated craft specialisation. There are indications that processes may occur in the burial of metalsmiths in the Indonesian archipelago similar to those identified on the Southeast Asian mainland. Although very small in quantity, the existence of iron slag, bronze slag, or fragments of casting moulds in some burial contexts, such as at Plawangan, Gilimanuk and Leang Buidane, seemingly confirm this assumption.

Central Thailand Sites

Evidence for the early metallurgy of central Thailand has been found in three sites, Khok Phlap, Ban Khok Rakaa, and Ban Tha Kae in the Chao Phraya Valley (Higham 1988:138). Khok Phlap, assumed to correspond to General Period B of northeast Thailand, yielded bronze items, such as barbed tips of arrows (Higham 1988:138). At Ban Tha Kae evidence for the transition between the use of bronze and iron working is more obvious (Higham 1988:138). Cultural deposition at this site consists of three phases (Hanwong 1985 cited in Higham 1988:138). The earliest has burials with grave goods including bronze bracelets, shell beads and earrings, stone bracelets with a T-shaped cross section, stone axes, and pottery. The middle period has iron and glass beads (Higham 1988:138).

Apart from Phu Lon, another copper mine with smelting activities has been recognised at Khao Wong Prachan hill, 15 km from Lopburi, in central Thailand (see Higham 1988:138; Pigott and Natapintu 1988:159). The copper smelting activities were found in seven separate locations. A significant quantity of copper slag, crucibles, clay moulds for the casting of bracelets, axes, arrowheads, and spears, clearly indicate copper working at this area (Higham 1988:138). An arrowhead and an axehead of pure copper were also recovered at Non Ma Kla, another Khao Wong Prachan site, together with fragments of clay furnace lining and tuyères (Higham 1988:138). In addition, the appearance of a copper ingot on the surface of Khao Wong Prachan may reflect the production of metal as well as finished artifacts (Higham (1988:138). It was suggested that metal working at both Khao Wong Prachan and Ban Tha Kae, 5 km to the south, developed contemporaneously, ca. 1500-250 BC (Higham 1988:138).

Non Pa Wai, another site in the Khao Wong Prachan valley, covering an area more than 5 ha, exhibited abundant waste from copper smelting over the whole surface (Pigott and Natapintu 1988:159). The waste comprised ash, fragments of crucibles, slag, fragments of moulds, ore minerals, ore-dressing tools, sherds, animal bone, stone tools, and fragments of stone bracelets (Pigott and Natapintu 1988:159). It has been suggested that the clay moulds from Non Pa Wai, were used for casting not only metal artefacts, such as socketed arrowheads and axes, but also for 'the casting of small ingots of copper' (Pigott and Natapintu 1988:160). The clay cups and conical moulds for casting ingots have interior diameters from 1 cm to over 10 cm (Pigott and Natapintu 1988:160). Considering the dense debris, Pigott and Natapintu (1988:160) proposed that the metal working was 'carried out over a substantial period by a sizable working population' and not only for fulfilling the local needs.

Another site, Nil Kham Haeng, about 2 km from Non Pa Wai, was an important copper resource (Pigott and Natapintu 1988:161). Consisting of approximately 5.50 m depth of cultural layers, this disturbed site showed a number of 'thin layers of crushed ore host rock with some crushed slag' (Pigott and Natapintu 1988:161). The other evidence for metalworking, consisting of slag, fragments of crucibles, and entire slag discs, was retrieved together with two burials and occupation waste such as animal bones, stone tools and cord-marked sherds (Pigott and Natapintu 1988:161). A bimetallic bracelet of iron and copper found in one of the two burials suggests a date in the later first millennium BC, comparable to the upper Non Pa Wai deposit (Pigott and Natapintu 1988:161).

Numerous socketed tools with heart shaped blades have recently been uncovered at Nil Kham Haeng (Weiss, cited in Bellwood 1997:279; White and Pigott 1996:164; Weiss and Pigott 1998:80). Weiss and Pigott (1998:80) propose that the production of 'standardised socketed "cordiform" implements' relates to 'the later site of Nil Kham Haeng (NKH, c.800-300 BC)'. These new finds are important as such tools, together with axes with crescent-shaped blades have been claimed as Balinese local types and included within Soejono types VI and V (Soejono 1972). In the Nil Kham Haeng context, such implements may have been utilised as 'projectile points, currency, ingots, or some sort of social/political marker' (Weiss and Pigott 1998:80). In addition, a clay bivalve mould for casting four small objects similar to Soejono type V-A axes was also recovered at Nil Kham Haeng (Pigott 1998, pers. comm. to Bellwood). These indications suggest that many of the Gilimanuk metal objects were derived from Southeast Asian mainland prototypes. This notion can be confirmed from Early Metal sites in Vietnam and other island sites as many similarities have also been pointed out (see e.g. Heekeren 1958; Bellwood 1997).

Besides the recognisable relationships between mainland and island Southeast Asian communities, Glover (1990) has also propounded that Ban Don Ta Phet in south central Thailand had some contacts with Vietnam and India. Bronze funerary items from this site have been grouped into containers, bird figurines and ornaments (Glover 1990:23). As many of the bronze containers were found incomplete in burial deposits, Glover (1990:23) suggested that they may have been 'deliberately broken or crushed before or during burial...'. Glover (1990:23-4) further stated that evidence for contact with India and the Dongson Culture of North Vietnam can be traced from some of the bronze vessels which had distinctive shapes. Contact with India was also quite possibly represented by the existence of stone and glass beads (Higham 1988:146-7).

Inland and Coastal Vietnam

White (1988:179) suggested that metallurgy in northern Vietnam during the first millennium BC displayed many developments distinct from those of northeast Thailand. However, it has been suggested that cultural deposits of the sites of the Bac Bo Region, were contemporaneous with General Periods A and B of northeast Thailand (Higham 1988:141). They can be divided into three sequential phases, Phung Nguyen, Dong Dau and Go Mun, the sites for which were concentrated in the Red River delta (Higham 1988:141, 144). While forty-one excavated sites of Phung Nguyen yielded copious pottery, grinding stones, stone adzes and stone ornaments, only the latest of the three Phung Nguyen phases in eleven sites contained deteriorated bronze fragments and slag (Higham 1988:141). The Phung Nguyen then developed into the Dong Dau phase ca. 1500 BC (Higham 1988:141). Located within the valley of the Red River, Dong Dau yielded a rice grain sample, pottery with similar style and decoration to that of Phung Nguyen, and 'compelling evidence for a local and vigorous bronze industry' (Higham 1988:142). The site has three dates, 1280 $\pm$ 100 BC, 1140 $\pm$ 70 BC, and 550 $\pm$ 130 BC. Fragments of stone and clay moulds used for casting axes and fishhooks were found here, so that the contemporaneity with General Period B is obvious (Higham 1988:142). Bronze implements from this site comprise socketed spearheads, arrowheads, and chisels (Higham 1988:142).

The Dong Dau phase grew into the Go Mun phase approximately at the end of the second millennium BC and ended in about the seventh century BC (Higham 1988:142). Consisting of about twenty-five sites, the phase revealed stone adzes and chisels, as well as bronze axes and chisels which were similar in form to the stone tools (Higham 1988:142). Other bronze objects comprised spearheads, arrowheads, fishhooks, narrow projectile points, bracelets, a sickle and a figurine (Higham

1988:142). Seemingly, the last two objects were cast by using a lost-wax technique (Higham 1988:142).

Higham (1988:144) propounded: 'The sequence of Phung Nguyen, Dong Dau, and Go Mun phases described here witnessed a major transformation with the development of the culture of Dong Son'. Different from the sites of the former three phases, the Dong Son site is located on the southern bank of the Ma River (Higham 1988:144). So far, evidence of the Dong Son culture has been obtained from burial contexts, which included clay vessels, bronze axes, spearheads, and knives as grave goods (Higham 1988:145). There are, however, at least three phases of development of the Dong Son culture. Following the earliest burial contexts which date to ca. 1000-500 BC, parallel to the Go Mun phase, comes the second and main phase dated to 500-0 BC (Higham 1988:145). This phase revealed a great increase in bronze artefacts, including new types such as daggers, swords, situlae, and drums (Higham 1988:145). Burials of the third and following phase, occurring in the first century AD (Ha Van Tan 1980, cited in Higham 1988:145), marked the latest prehistoric phase by revealing artefacts from Han Dynasty China such as seals, coins, mirrors, and halberds (Higham 1988:145).

The appearance of distinctive bronze artefacts such as drums, situlae (small buckets), and decorated rectangular 'plaques', along with fragments of a very large crucible and four clay moulds, indicates a local bronze industry in Dong Son (see Higham 1988:145). Bellwood (1997:271) suggested that such bronze items and lost-wax techniques indicate that the northern Vietnamese 'local genius' had spread throughout other Southeast Asian regions. Recovered in a burial of the Lang Ca cemetery, the moulds were used to cast an axe, a spearhead, a dagger handle, and a bell (Higham 1988:145). Besides objects for ritual or ceremonial occasions and 'personal weaponry', Higham (1988:145) suggested that bronze artefacts of Dong Son, such as socketed ploughshares, also reflected 'a direct application of metallurgical skills to the intensification of agriculture'. In contrast to the bronze artefacts, iron objects very rarely appeared in Dong Son burials, and some were probably imported from China (Higham 1988:145; Bellwood 1997:271).

It is worthy of note that a principal difference appears between jar burial practice in northeast Thailand and in central coastal Vietnam (Higham 1988:151). In contrast to Vietnam, burial jars from General Periods A, B, or C of Thailand were never used for burying cremated bodies (Higham 1988:151). Interestingly, cremations have also never been found in Indonesian jar burials relate to the Early Metal Phase. This suggests a closer relationship between early Indonesian and Thai metallurgy. Nevertheless, the former notion about a close relationship between Indonesian metal objects and the Dong Son culture (e.g. Heekeren 1958; Bellwood 1997:271) still has supporting evidence, especially in the appearance of bronze kettledrums. Bellwood (1997:269) has also proposed: 'The Dong Son archaeological assemblages are of considerable importance because the earliest metal goods found in the Indo-Malaysian Archipelago are generally of this type, rather than of direct Indian or Chinese inspiration'.

Similarities as well as differences can be seen in the other regions of metal working, such as the Chao Phraya and Red River valleys (Higham 1988:146). The cave of Tham Ongbah in the Chạo Phraya valley, for instance, contained 'the remains of five drums of clear Dong Son affinities' as well as iron tools in association with burials in wooden boat-shaped coffins (Higham 1988:146). A series of artefacts of clear Dong Son affinity, including a fragment of cast iron and the remains of ornamented drums and bowls, has also been reportedly recovered at Dermbang Nang Buat in the Chao Phraya valley (Suchita 1985, cited in Higham 1988:146). This suggests that the Chao Phraya valley developed its own metallurgical techniques, letter to be influenced from Dong Son sources.

Southeast Asian Metallurgy in Comparison

Bellwood (1976:415) pointed out that assemblages of the Early Metal Period in the Talaud Islands 'are very close in general content to the Philippine assemblages from the Tabon Caves on Palawan (Fox 1970) and Kalanay Cave on Masbate (Solheim 1964)'. The Early Metal Period assemblages of Tabon Cave comprised jar burials, and the majority of metal artefacts were recovered in association with burials once placed inside large pottery jars (Bellwood 1976:415). Commencing at approximately 500 BC in the Tabon Caves (Fox 1970 cited in Bellwood 1976:415), the jar burial tradition is spread throughout South Vietnam, 'the islands around the Sulawesi and Sulu Seas (northern Borneo, Talaud, central and southern Philippines) and in parts of the Lesser Sundas--especially Sumba' (Bellwood 1976:415; 1997:296).

The Tabon bronze assemblages were composed of 'socketed axes with splayed and rounded blades, socketed spear-heads, tanged arrow-heads, knives, and a possible barbed harpoon'. In addition, baked clay moulds for bronze axe casting were also present (Bellwood 1976:415). In this regard, Bellwood (1976:415) suggested that local productions, indicated by the casting moulds, probably utilised imported tin or scrap metal brought from the mainland of Southeast Asia. Other grave goods included gold, carnelian and agate beads, bracelet and lingling-o earrings of jade, and decorated small pots (Bellwood 1976:415; 1997:303). Kalanay Cave on Masbate Island, meanwhile, also yielded Early Metal Age artefacts, such as 'a bronze miniature bell, an iron knife, glass beads, and decorated pottery related to that found in Tabon and the Talaud Islands' (Bellwood 1976:416).

Another interesting open jar burial site in the central Philippines is Magsuhot on Negros Island, producing baked-clay human and animal figurines, skeletal remains of pig and chicken, and about seventy 'accessory' pottery vessels (Bellwood 1997:303). The only metal object found was an iron knife, inside a jar which 'was connected to the surface by a tube of stacked pots', but identifiable bones could not be found (Bellwood 1997:303).

Pottery similar to that of Leang Buidane, some fragments of copper/bronze and iron artefacts (e.g. a tanged spearhead and a small knife) and a small number of carnelian beads were revealed in an Early Metal phase site in Sabah, that is from the cave of Agop Atas in the Madai massif (Bellwood 1997:302). Indication of metal working in Sabah, however, was revealed in another cave site in the Tapadong massif. A soft stone casting mould was found in association with a copper/bronze socketed axe, and eleven trapezoidal stone adzes in the Tapadong jar burial assemblage (Bellwood 1997:302). The appearance of stone adzes indicated continuity of usage while metalworking was carried out locally (Bellwood (1997:302). Concerning the similar case of the Kuningan stone cist, in western Java, however, Soejono (1990) suggested that the appearance of stone adzes in association with burial indicated a change in their employment, from practical into symbolical use.

Bellwood (1997:302-3) suggested that the Early Metal Phase on Talaud and the adjacent areas, Sabah and the Philippines, occurred approximately in the first millennium AD. In this regard, Bellwood (1976:419) gives an important notice that the Dongson type artefacts, especially Heger I drums, were spread from the mainland of Southeast Asia throughout the southern islands of Indonesia to western Irian, but were 'absent from Taiwan, the Philippines, northeastern Indonesia, and extremely rare in South Vietnam'. He further noted that in contrast, 'the practice of jar burial, virtually absent in former areas of Dongson influence' but was 'well developed in the latter regions, including South Vietnam...' (Bellwood 1976:419). Worthy of mention here is that jar burial sites are not virtually absent in Java, but rare. They are found in Anyar at the northwest tip of Java, in Plawangan and probably in Buni. Jar burials are currently reported Kunduran, Sumatra, where an investigation is still in progress. However, the origin of the jar burial tradition is a subject of debate. Bellwood (1997:306-7; 272) argued that although double jars put mouth to mouth appear in Japan (in horizontal position) and in India (in vertical position), 'the basic artifact forms, especially in metal and pottery' were different, so that the jar burial tradition of Austronesia was probably 'an indigenous development'.

As a whole, evidence available from the Indonesian Early Metal sites suggests that the influence of metallurgy from the mainland of Southeast Asia coincided in time with the wide spread trading networks that brought other imported materials from either continental Asia or neighbouring islands. Evidence from Gilimanuk and Pasir Angin may indicate that the introduction of bronzeworking to Indonesia succeeded the adoption of iron-working and the innovation of bimetallic artefacts in Thailand. Iron artefacts, including a bimetallic spearhead in Gilimanuk, appeared in the same layer as bronze and gold-like metal objects. This evidence supports the notion that both bronze and iron working were introduced together. While ironworking may have been introduced in approximately 500 BC to the mainland of Southeast Asia (see e.g. Stech and Maddin 1988; Higham 1996:5), it is unlikely that the introduction of metallurgy to Indonesia was taking place at the same time. In this case, Bellwood's (1997:268) suggestion that the date could be pushed 'closer to 200 BC' is supported. The close similarity between Ban Chiang and Gilimanuk does of course not simply indicate a single direct relationship. Furthermore, other features which occur in Gilimanuk but not in Ban Chiang, such as fragments of a smashed bronze drum and gold foil eye and mouth covers, clearly reflect broader contacts. As has been suggested by O'Connor and Harrisson (1971) 'leaf-shaped gold' artefacts appear not only in Southeast Asia (i.e. Philippines and Sarawak), but also in China and South India. In addition, a pair of gold foil eye and mouth covers was also uncovered from Plawangan.

While Gilimanuk burial contexts show significant similarities with Ban Chiang, the Plawangan jar burial site indicates remarkable parallelism with the Sa Huynh sites of southern Vietnam. Besides jar burials, Bellwood (1997:275) suggested that 'the Sa Huynh sites reveal greater usage of iron than the Dong Son sites', for making tools and weapons. Bronze, meanwhile, was used particularly to produce ornaments such as bracelets, bells, and small vessels (Bellwood 1997:275). Interestingly, a small number of gold ornaments, glass and banded agate beads (see figure 4.2) do occur in Plawangan and the Sa Huynh sites.

Although approximate similarities in behaviour and style of material culture, together with importation of exotic commodities, may indicate a certain degree of contact, the growth of local development in metalworking is also evidenced. Soejono (1977:9) has suggested that bronze objects from Bali show local characteristics, but the Southeast Asian concept of metallurgy and geometric decoration can also be seen.

The appearance of metal objects in Bali with distinctive features that so far have no outside parallel, such as the pentagonal plates, suggests the ability to produce their own metal artefacts by using scrap and possibly imported metal ore. As has been indicated in this research, the existence of certain types of bronze axe together with variants shows the ability to modify introduced forms. This might also

Figure 4.2. A banded agate bead among other beads of glass, stone, shell and fish vertebrae from Plawangan (from Soegondho 1995:54, plate 20).

be demonstrated by the use of after-casting treatment on a hollow bracelet (see Aziz and Priyono 1997), that did not appear on bronze arm and leg bracelets or rings from Ban Chiang or Non Nok Tha (White 1988:177). While Ban Chiang iron spearheads were cast with bronze handles, similar specimens appear in Gilimanuk, but the bronze handles were cast separately.

A greater scale of metalworking and metal production that was seemingly more focused on ironworking has been indicated in Tamblingan in Bali, but under a well-organised Hindu kingdom. The development of metallurgy in Bali culminated in the ability to create local development as demonstrated by the Pejeng bronze drum. However, the drums are not part of Hindu (Indian) custom, so that speculation emerges. It is quite possible that metallurgy developed rapidly around the second half the first millennium AD, under a highly socially differentiated and well-organised non-Hindu people. This notion is supported by the existence of a sarcophagus funeral custom before Indian influence intruded intensively. This non-Hindu custom still continues in some cultural pockets, that are known today as Bali Aga.

Bronze Alloys and Bronze Usage

Composition analysis of Indonesian bronze specimens is still limited. This limitation has triggered some speculations concerning alloys. Heekeren (1958:5) and van der Hoop (1938:78 cited in Soejono 1977:298) assumed that unlike those of the Medes and Persians, Indonesian and Southeast Asian bronze objects had a high lead content and almost an absence of tin, so that the term 'bronze-lead alloy' emerged. Based on recent research, Soejono (1977:20-4) also argued against the suggestion that many bronze objects, including the Balinese objects, have a higher tin than lead content. He further argued that the former assumption leads to the speculation that a high-lead bronze alloy is older than a high-tin bronze alloy (Soejono 1977:298).

Hollmann and Spennemann (1985) have stressed the importance of metal composition and implications for chronology, as well as the categories of artefacts produced. While the addition of tin will affect mainly the colour of the metal, lead is useful for lowering the melting-point and reducing the risk of flaws when the alloy is poured into a mould (Hollmann and Spennemann 1985:91). In the case of Dian metal production in Yunnan Province, a small amount of lead put in a copper alloy or low tin-bronze alloy relates to the earlier part of the sequence of Heger type kettledrum production (Hollmann and Spennemann 1985:94, table 1 and 2).

The low lead and tin contents contrast with Southeast Asian drums and weapons, where a high proportion of lead is usually added to high tin-bronze alloys (see Hollmann and Spennemann 1985:94, table 1; Stech and Maddin 1988). Chronological relations between a small portion of lead put into a tin-bronze alloy in the Early Period and a considerable increase in lead in the Late Period of Thailand is clearly demonstrated in Ban Chiang (Stech and Maddin 1988: table 15.1). However, whether the appearance of notable variation in the content of lead indicates that it was deliberately added to tin-bronze alloy, is a subject of question. White (1988:178) claimed that lead 'positively affects casting properties but negatively affects mechanical properties of a copper alloy...'. While Seeley and Rajpitak (1984, cited in White 1988:178) argued that the increase of lead does not relate to 'greater complexity of design', White (1982, cited in White 1988:178) further claimed that the increase of lead in Ban Chiang Middle Period bronzes 'might relate to greater complexity of form in the Middle Period bangles'.

High-tin bronze appears in a few items of the Ban Chiang Late Period, especially ornaments (Stech and Maddin 1988:171). Bowls from Ban Don Ta Phet, however, were also produced using this alloy that may relate to 'a special decorative purpose' (Stech and Maddin 1988:171). High-tin in bronze alloy will produce lighter colour and shinier objects (Stech and Maddin 1988:171). Nevertheless, the apparent existence of high-tin alloy in some corroded specimens from the Ban Chiang Early Period, according to Stech and Maddin (1988:163, 168) may be because the result of PIXE (proton-induced X-ray emission) for analysing bronze elements and microstructure analysis are not compatible; the amount of tin could increase because of 'the corrosion process or from an aspect of the PIXE instrumentation or both'.

In the case of the Gilimanuk bronze specimens that have been analysed (Soejono 1977; Aziz and Sudarti 1996; Aziz and Priyono 1997), 2.49 % to 14.92 % of tin and 0 % to 8.28 % of lead appear, but the amount of copper is interesting to consider (see table 2.3 and 2.4). While the amount of copper in ornaments (an earring and two bracelets) is 62.79 % to 73.98 %, axes are have only 34.56 % to 52.43 % of copper. The proportions as found in ornaments are relatively similar to those in Ban Chiang specimens from the Later Period (see Stech and Maddin 1988, table 15.1). Whether this supports the notion about close relation and importation of metal objects into Indonesia during the Late Period of Thailand (ca. 300 BC to AD 200), needs to be further investigated. The small amounts of copper in the axe specimens, meanwhile, remain a question especially in relation to their function.

Soejono (1977:18) argued that the distances and the difficulties in obtaining metal raw material have limited metal production to only certain objects, in particular non-practical objects, and they were only owned by wealthy people. Bernet Kempers (1988:289) has also stated: 'Bronze has always been a rare and costly material that was reserved for special personages, for religious purposes, and for exceptional social occasions'. Bernet Kempers (1988:289) argued further: 'The occurrence of large and imposing bronzes bears evidence of stratified society as well as an advanced technology'. Bronson (1996:179) clearly refuted the former argument about the 'superior efficiency' of metal tools and weapons compared to wood or stone tools. He argued that due to the limitation of metal sources, it is unlikely that metal tools were adopted in a short time; many societies 'used what metal they had mainly for ceremonial purposes' (Bronson 1996:179).

Those arguments are seemingly reasonable, but might distort if they are applied to whole periods and geographical areas in terms of the development of metallurgy and the emergence of social differentiation. Moreover, a current experiment undertaken by Mathieu and Meyer (1997) does not support Bronson's (1996) rejection of the 'superior efficiency' of metal tools. The experiment aimed to measure the degree of efficiency of stone, bronze and steel axes, using replicas of the original axes. Mathieu and Meyer (1997:348) concluded that bronze axes are as efficient as steel axes for felling trees, because the hardness of metal is not so important for this purpose. However, stone axes are less efficient compared with metal axes because of their relative thickness, 'not necessarily only due to the superior sharpness of the cutting edge of the metal axes' (Mathieu and Meyer 1997:348).

By referring to this experiment, it would not be a surprise if metal tools and weapons became relatively rapidly favoured. In this case, the appearance of socketed-shafts, or the symmetry and blade angle found in axes from Gilimanuk, quite possibly reflect certain practical functions of the original axes. Some evidence from burial contexts also strongly supports the notion that bronze tools may have practical functions, before being utilised as funeral gifts. In this case, Glover and Syme (1993:67) have mentioned that two socketed axes complete with long wooden hafting have been found in a log coffin burial at Chau Can, northern Vietnam. The two samples from Vietnam 'at least were not axes in the modern sense but probably shoulder pressure wood working tools' (Glover and Syme 1993:67). It is a logical consequence that a new type of tool (i.e. metal tools) would only be valued if the users perceive practical benefits in their daily life, and based on this belief, such tools would be included as burial gifts. It is important to notice that, as has been widely accepted, metal tool production needs experience and experimentation. So, it is unlikely that once metal implements could be produced successfully, they would rapidly turn to objects of ceremony. Moreover, the recent research suggests that only low social differentiation appeared in the Early Metal Phase sites of the mainland of Southeast Asia (see White and Pigott 1996:157).

The fact that in the islands of Southeast Asia metal tools appear in the same contexts as on the mainland (i.e. burial contexts), however, triggers a question as to whether in the island contexts the metal tools were never used for practical functions. The value of metal and the scarcity of resources usually traps us to consider mainly ceremonial purposes and give no attention to practical function. While recent evidence is still not enough to answer such a question, more investigation on working edge and use-wear scars should be under taken in the future.

EXCHANGE NETWORK AND THE SIGNIFICANCE OF THE INDONESIAN EARLY METAL COASTAL SITES

White and Pigott (1996) assume that small-scale metal production ('community-based craft specialization') in northeastern Thailand developed into regional specialisation in later sites such as Non Pa Wai and Nil Kham Haeng in central Thailand. This is indicated by greater numbers and sizes of metalworking related items. This notion may coincide with socioeconomic development that was reflected in the variability of burial gifts and the occurrence of foreign goods. The appearance of foreign exotic materials, such as metal artefacts, precious beads and ceramics, far from their centres of production is widely accepted as marking the existence of an international exchange network approximately in the second half of first millennium BC and the first millennium AD (see e.g. Glover 1990; Higham 1996; Bellwood 1997).

Within the mainland of Southeast Asia, the exchange system which involved 'lowland-upland' regions has been seen as the way to transfer not only goods, but also information by 'the lines of least resistance following river courses or coastal routes' (Higham 1988:143-4). In the case of metal, Bronson (1992:104) propounds that '...metals are eminently tradable commodities: valuable, easily transported, scarce or absent in the vicinity of most populated places, and not at all easy to make unless one has substantial experience and skill'. Therefore, trading networks have also been suggested to accommodate the rapid spread of bronze working (Higham 1988:144).

Bellwood (1997:272) suggests that the Chams in Sa Huynh sites might have introduced ironworking to the island Southeast Asian people, because they occupied areas close to 'the northern Vietnamese centers of metallurgy'. However, this Austronesian-speaking community was unlikely to introduce bronzeworking or bronze drums, as 'their direct contacts with the bronzeworking centers of the Dong Son region seem to have been rather limited' (Bellwood 1997:272). In this case, inland routes through Thailand and Peninsular Malaysia or sea routes are quite possible (Bellwood 1997:272).

According to Higham (1988:143) exchange for obtaining rare merchandise 'was an adaptive mechanism to ensure that the social and technological necessities in settlement expansion were available'. Success and failure in obtaining "exotic" and prestigious goods will influence the degree of social power or status (Higham 1988:143-4). Considering the rarity of bronze objects in burial contexts, however, Higham (1988:144) pointed out: 'The attainment of status was flexible rather than fixed'.

Soejono (1990:289) has suggested that trade routes can be traced by considering the place of recovery of bronze objects, especially bronze axes and drums, from southern Sumatra to the western coast of Irian. Such a suggestion, however, must be supported by a holistic investigation which is focused not only on the details of style and chemical components of the specimens, but also their contexts and relationship with the broader geographical range of the spread of metallurgy. Problems can emerge here as metal implements are usually long lasting; they can be inherited from generation to generation, or traded secondhand from one place to others. A similar situation could also occur with other durable artefacts, for instance beads.

Soejono (1977:273) and Ardika (1987:31) assumed that the Gilimanuk inhabitants had interacted with inland Balinese people (i.e. Manuaba) to obtain metal items. This needs to be confirmed with dating. So far there is no evidence for inland metalworking that preceded or paralleled the use of Gilimanuk for settlement. The scenario for the development of metalworking in Bali as has been mentioned only supports later inland metalworking. Moreover, the location of Gilimanuk at the western coast of Bali is more accessible to contact with other sites along the north coast or even with other regions outside Bali, rather than with inland sites.

Geographically, the location of Gilimanuk is more hidden than the northern and west coasts of Bali. In this case, contact with westerly regions to obtained metal items and other merchandise could be through more open coastal sites that can facilitate anchorage. While archaeological evidence for supporting this notion is so far limited to Sembiran, old Balinese inscriptions and several more recent travelers' notes may provide important information to trace some places that had been used for anchoring.

The early Dutch ships anchored at three places, i.e. Jembrana and Kuta on the west coast of Bali and Buleleng on the the north coast (Hanna 1976:8). Kuta and particularly Buleleng continued to be used as harbours until very recent times (see Chegaray 1955:30-2). In 1871, the Bali Strait that split Java and Bali was crossed from Banyuwangi harbour at the eastern tip of Java by using a *jukung* (a traditional boat); this boat anchored at Prancak Village in Jamburana (Jembrana) on the western coast of Bali (see Vickers 1994:10). Gilimanuk, meanwhile, is the closest spot to cross the Bali Strait to and from Banyuwangi, especially for inland travelers, but this was opened as a ferry harbour only in 1963 (Proyek Penelitian dan Pencatatan Kebudayaan Daerah 1978). All the information indicates that changes of coastline could influence the rise and fall of a port.

Considering the location, it would not have been surprising if Sembiran and adjacent areas (e.g. Julah, Pacung Bangkah) had become ports at the beginning of the first millennium AD, and developed further as an international port region in around the 10^{th} to 12^{th} century. This is supported not only by the existence of exotic imported materials, but also by the Sembiran inscription (922 AD) and other inscriptions that are kept in Julah (Tim Ekskavasi 1995/6; Ardika 1991). Ardika (1991; see also Tim Ekskavasi 1996) also stated that the old harbour in Sembiran was not used any more due to sedimentation along the beach. Supporting evidence is provided by the result of recent investigation along the north coast of Bali that shows positive indications of archaeological sites (see Suantika 1996).

Based on the data accumulated, Gilimanuk was only inhabited during the metal age. Such evidence triggers a speculation that the inhabitants formerly occupied a further inland region during the neolithic period. They might have then moved to the seashore to get easier access to merchandise, or might have been attracted by rich coastal resources. Unfortunately, evidence for the neolithic period in Bali is very poor. Stone adzes have never been found in situ (Sutaba 1980:19-22). In this case, tracing the continuity between the two periods is still difficult because of the lack of excavation focused on problems concerning the neolithic stage. The process of introduction and experimentation in metalworking could have taken place in coastal sites such as Sembiran and Gilimanuk, where first or direct contacts might have occurred. This is supported by the appearance of a small amount of metalworking related artefacts in both sites. However, more elaborate metal objects could later have been produced by settled inland farmers who have time during the farming calendar, rather than coastal inhabitants who are usually more mobile.

CHAPTER 5

CONCLUSIONS AND FUTURE RESEARCH

CONCLUSIONS

The results of my research show that some of the Early Metal Phase sites in Indonesia have parallels in terms of the contexts of metal items and the appearance of metalworking-related artefacts. Similarities in the types of metal objects, meanwhile, can only be seen in a few sites, for example between bimetallic spearheads that were wrapped by using fiber from Gilimanuk and Pasir Angin. They might have been produced by a similar technique, in that the bronze handles were cast separately from the iron blades. In addition, leaf-shaped gold objects have been uncovered not only from Gilimanuk, but also from Plawangan. Such evidence, together with the appearance of other exotic merchandise, (i.e. glass and precious stone beads), gives support to the notion of the establishment of intensive contacts between Southeast Asian regions.

To some extent, the Indonesian sites examined and some of the mainland Southeast Asian sites also indicate similarities. Parallelisms occur between types of metal artefacts and their contexts (i.e. burial). Examples of close relationship can be seen between Gilimanuk and Ban Chiang, or between Gilimanuk and Nil Kham Haeng. Comparisons of chemical components also confirm this notion. The introduction of metallurgy was apparently not merely related to the types of artefacts and techniques of metalworking, but also to the behaviour in using and maintaining the artefacts. As in Early Metal Phase sites of northeast Thailand, the quantity of metal objects in the Gilimanuk reflects only low social differentiation. In addition, it is also possible that fragments of axes in the Gilimanuk burial context and fragments of a bronze drum may have been deliberately "killed", as in Shizhaishan (in Yunnan) and the ethnographic Karen (Bernet Kempers 1988:73).

The domination of iron in Plawangan is in contrast to other sites, in particular Gilimanuk. This domination may correlate with the existence of high social differentiation, as shown by the use of a bronze kettledrum as a burial container. In

Thailand, higher social differences appeared a few centuries before the Christian Era, coinciding with the introduction of ironworking. This may imply that Plawangan was introduced to metallurgy later than the other sites together with an increase in social differentiation.

Considering the absence of moulds for casting axes in Bali, it is unlikely that the Gilimanuk bronze axes were obtained from inland Bali by trade. The inland metalworking activity of Bali, as indicated by the Tamblingan discoveries, only flourished from the 10th to about the 14th century AD, and was seemingly more concentrated on iron production. Evidence from Nil Kham Haeng in the Khao Wong Prachan valley, central Thailand, meanwhile, provides an alternative for tracing the origin or prototypes of the Gilimanuk bronze axes, that have so far been claimed as Balinese local types. Bronze implements similar to the Soejono VI axes and a clay mould for casting implements similar to the Soejono V-B axes have been recovered from that site. In Glover and Syme's (1993:69-71) classification, these axe types are classified as types 12 and 13.

In addition to the quite clear evidence for types of metal artifacts derived from other sources, local development can also be recognised. This, for example, is indicated by the pentagonal plates, as suggested by Soejono (1977), and also by the variants of the type V axes and the bimetallic spearheads in which the blades and handle were cast separately. My examination of the Gilimanuk bronze axes shows that Anggraeni variant 2 of the Soejono type V axe may represent a solution to the problem of the scarcity of metal sources versus the high demand for metal items as indicators of social status. Together with Anggraeni variant 3, Anggraeni variant 2 may imply trends and changes in function from combined practical and symbolic use to a symbolic use only.

The location of Early Metal sites along the coastlines of the archipelago provided greater opportunity for direct contact with interisland travelers, and conversely, the coastal inhabitants also had the opportunity to travel outside their homeland. The introduction and the acceptance of metallurgy coinciding with an exchange network and some degree of importation, showed that the Indonesian people were openminded about new introduced ideas and materials. Such contacts could happen more rapidly when the demands for exotic materials increased. In this case, coastal inhabitants could have conducted experiments in metalworking earlier than inland people. The fragment of a stone casting mould from Sembiran seemingly supports this assumption. Meanwhile, the small number of metalworking-related artefacts, compared to the prolific evidence of metalworking from Tamblingan, indicates that early metalworking and metal production occurred on a very small scales.

The appearance of two sarcophagi and well-made pottery in Gilimanuk implies some later influence from inland sites. The sarcophagus manufacture and metalworking apparent in inland sites may correlate with a subsistence focus on rice cultivation, as has been suggested by Ardika (1987). While iron-based metalworking is well documented as appearing during the Hindu kingdoms, the remarkable bronzeworking that produced local drums of Pejeng type, is still undated. However, such artefacts certainly do not have a direct relationship with Indian influence. Even so, the close dates between the occupation of Gilimanuk and the early influence of Indian culture at Sembiran suggest that no time gap occurred between them.

FUTURE RESEARCH

More intensive research towards metal production activities, especially in Gilimanuk, needs to be undertaken in the future. In this case, more attention needs to be given to non-artefactual finds and non-burial contexts outside Zones I and II. In addition, the question of whether metal implements in burial contexts were ever utilised in daily life needs to be confirmed with an intensive research focus on use-wear analysis.

A broader investigation that involves other coastal sites surrounding Gilimanuk is needs to be undertake to find out their interrelationships, such research should include Cekik. Soejono (1977) and Ramelan (1988) have suggested that the pottery from both sites is similar, but there was no attempt to compare their chemical components. Therefore, SEM analysis to complement Soegondho's (1993) results should be continued, particularly on pottery from Cekik.

APPENDIX

SEM ANALYSIS OF POTTERY FROM GILIMANUK

A scanning electron microscope (SEM) analysis was used to find out the chemical characteristics of twenty three sherds samples from Gilimanuk. Chemical characteristics of the clay pastes and inclusions can be used to identify 'production, exchange and consumption patterns' (Summerhayes 1996:82). A chemical analysis using an SEM is more beneficial than other conventional methods, as it can discriminate and analyse separately the clay and mineral inclusions. The samples can also be compared by using other instruments, such as a low power binocular microscope.

Gilimanuk pottery has been suggested to be similar to pottery from Cekik, and possibly brought into Gilimanuk as an exchange commodity (see Soejono 1977; Ramelan 1988:93). The samples analysed comprise fifteen plain sherds and eight net impressed sherds, recovered from layer 3 in sector S.VII, and from layers 3 and 3/4 in sector S.X (see table 1 and figure 1).

Preparation

Briefly, samples were impregnated with epoxy resin to form a pellet, which was subsequently highly polished. Two or three samples were placed into a single pellet. For preparing flat surfaces for SEM analysis, several steps were followed:

1. The sherds were first cut using a saw into sections approximately 10 to 20 mm long, and 15 mm wide.
2. Two or three samples were placed side by side in one plastic mould (25 mm diameter). Surfaces to be cut were placed facing downwards in the mould. Each sample was labeled and each row recorded.
3. Samples were then immersed in a mixture of 80 % epoxy resin and 20 % hardener. After the mixture is poured, the samples must be left for about 15 minutes until the liquid become solid.

TABLE A.1. ANALYSED SHERDS FROM GILIMANUK

No.	Code	Decoration
1	GLM/VII/10/1	plain body
2	GLM/ VII/10/2	plain body
3	GLM/VII/10/3	plain body
4	GLM/X/228/3	net impressed body
5	GLM/X/197/3	net impressed rim
6	GLM/X/123/3	net impressed body
7	GLM/X/235/3/4	net impressed rim
8	GLM/VII/167/3	net impressed rim
9	GLM/VII/122/3	net impressed body
10	GLM/VII/117/3	net impressed body
11	GLM/X/150/3	net impressed body
12	GLM/VII/10/13	plain body
13	GLM/VII/10/14	plain body
14	GLM/VII/10/15	plain body
15	GLM/VII/10/4	plain body
16	GLM/VII/10/5	plain body
17	GLM/VII/10/6	plain body
18	GLM/VII/10/7	plain body
19	GLM/VII/10/8	plain body
20	GLM/VII/10/9	plain body
21	GLM/VII/10/10	plain body
22	GLM/VII/10/11	plain body
23	GLM/VII/10/12	plain body

Figure A.1. Net impressions on Gilimanuk sherds.

4. The samples was then heated in an oven at 30° C for 24 hours, and then left for another day before being taken from the moulds.

5. The surfaces to be analysed were ground gradually under running water, using five different wet and dry abrasive papers, from coarse (P120, P180 and P280 grains per square cm) to fine (P600 and P1200 grains per square cm). The objective is to expose the sherd cross section and remove excess resin. The gradual grinding under running water is intended to avoid scratches.

6. After the pellets dried, their flat surfaces were covered with diamond paste and polished using two kinds of polishing lap with a oil base in a Kent 3 automatic lapping and polishing unit. The first polishing was done with a 3.00 micron tin lap for 10 minutes and the second with a 1.00 micron pellon cloth for another 10 minutes. These laps belonged to the Department of Geology, ANU (courtesy John Vickers).

7. After being polished, the surface of each pellet was cleaned with ethanol, and then carbon coated. Coating by using carbon that "does not significantly absorb the energy X-rays" is needed to "provide a path for the probe current to flow to earth" (Reed 1977:178, quoted in Summerhayes 1996:88).

Chemical Analyses

The analyses were carried out at the Electron Microscope Unit, Research School of Biological Sciences, ANU, using the JEOL 6400 (SEM 1990). This equipment consists of an Oxford ISIS EDXA (energy dispersive X-ray analytical system) with ATW window (sensitive down to boron), Nordif EBSP ("Kikuchi Backscatter") analysis system, Robinson and solid-state backscatter detectors, forescatter detector, transmitted electron detector, SACP, and 4 (1024x1024) manipulatable stored image frames (ANU EMU version 21, 1998). Other materials and components are a LaB6 or tungsen filament, video overlay-based online point - to-point measurement, diffusion and sputter ion pumps, 10-7 mbar, 70 mm roll film, videographic printer, video output, and 1024 x 768 slow-scan image acquisition to network PC (ANU EMU version 21, 1998).

Each pellet of two or three sherds was clamped and put into the sample chamber. The samples were observed 'on both a cathode ray tube or attached video camera and points can be selected for analysis by moving the specimen holder' (Summerhayes 1996:84). Summerhayes (1996:83) explains that in SEM analysis 'each atom emits a characteristic X-ray wavelength and energy'. In this technique, X-rays are generated 'by bombarding a sample with an electron beam' (Summerhayes 1996:83). Ten points of a clay paste area in each sample were chosen by using the X and Y axis precision control mechanism until the point for analysis was under the beam (Summerhayes 1996:84). The resulting image was then magnified up to 6500 times.

Nine elements (Na, Mg, Al, Si, K, Ca, Ti, Mn and Fe), were chosen to be analysed for each point. The elements chosen are 'those whose abundance vary for different clay types but are constant within one clay deposit' (Summerhayes 1996:88). The results for each element and compounds of clay elements, from one spot were normalised by percentage. For inclusion analyses, eight to ten distinctive minerals were chosen for each sample (see figure A.2 and A.3). The results for the mineral inclusions were not normalised.

Statistical Analysis

The results of the chemical elemental analysis were statistically analysed. This analysis, done by Dr. Glenn R. Summerhayes of Department of Archaeology and Anthropology ANU, was aimed to group the ceramics by elemental composition using the Chemical Paste Compositional Reference Unit (CPCRU) concept. In this analysis, Summerhayes applied Principal Component Analysis (PCA) using Wright's MVARCH (1991, cited in Summerhayes 1996:90). In order to 'identify major clusters and group structure' (Summerhayes 1996:90), a rotated PCA was also used. Summerhayes (1996:90) stated that 'object scores from PCA' and groupings were defined 'subjectively and not by some cut off similarity measure'. Summerhayes (1996:90) also stated that the groups displayed by PCA need to be compared with dendrograms that are produced by hierarchical clustering analysis using the Group

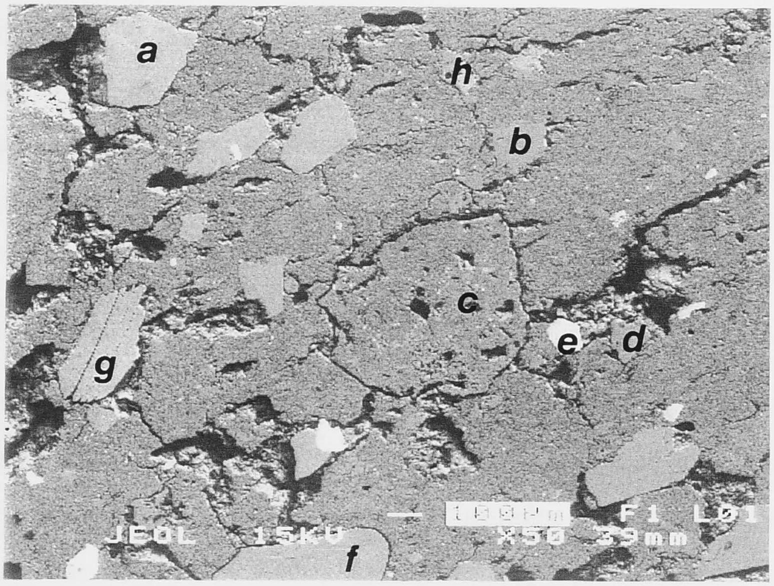


Figure A.2. Mineral inclusions in a decorated sherd from Gilimanuk (sample number 5): (a,f,g) pyroxene-chromian augite; (b) plagioclase feldspar-labradorite; (c,h) plagioclase feldspar; (d) olivine-chrisolite; (e) spinel-titaniferous magnetite.

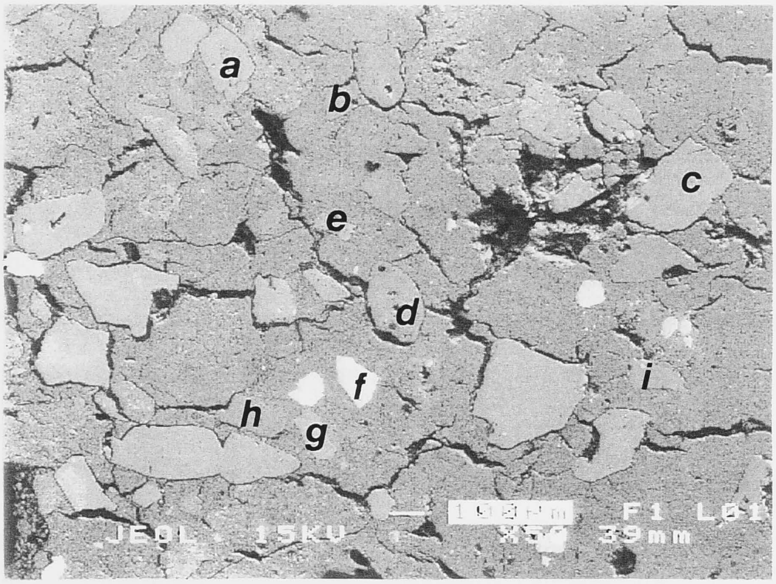


Figure A.3. Mineral inclusions in a plain sherd from Gilimanuk (sample number 21): (a,c,e,g) pyroxene-chromian augite; (b,h) plagioclase feldspar-andesine; (d) carbonate; (f) Fe enriched-spinel; (i) plagioclase feldspar-labradorite.

Average technique. This is useful 'to assess if such groupings are universal or a product of the technique' (Summerhayes 1996:90). The statistical analyses of the Gilimanuk samples show that the samples are within one CPCRU, thus have one clay source (see figure A.4).

Analysis of the Inclusions

Fabrics were also analysed using a low powered microscope (x20) which complemented the SEM analysis of the inclusions. Two macroscopic pastes were identified. The bulk of the samples analysed (18 samples - 78 %) are of one fabric, that is a calcareous one, mixed with plagioclase and pyroxenes; some with quartz, some with amphiboles, and some with spinels. This group probably came from beach sands of mixed coralline and volcanic composition.

Five samples (22 %), however, came from a non-calcareous fabric (see table 2 sample numbers 2, 5, 9, 10, 15); all with plagioclase and pyroxenes, and all except one with spinels. None had amphiboles. This indicates a volcanic sand, either of beach or stream origin.

Discussion

Chemical analysis showed that all pottery came from one clay source, while both a chemical analysis and a macroscopic analysis of the inclusions identified two sources of sand. According to Summerhayes, the sands from all the sherds are basically the same, i.e. volcanically derived, containing plagioclase, pyroxenes and magnetite. But one fabric has calcareous inclusions, the other does not. Did they come from two different beaches? If so, Summerhayes reminds us that the differences between fabrics need not be culturally important, nor need they indicate different production strategies.

The importance of this study is that if one were to classify the sherds solely by macroscopic qualities, then two groups would be defined on the temper differences, and erroneous production patterns perhaps inferred. Yet, from the chemical

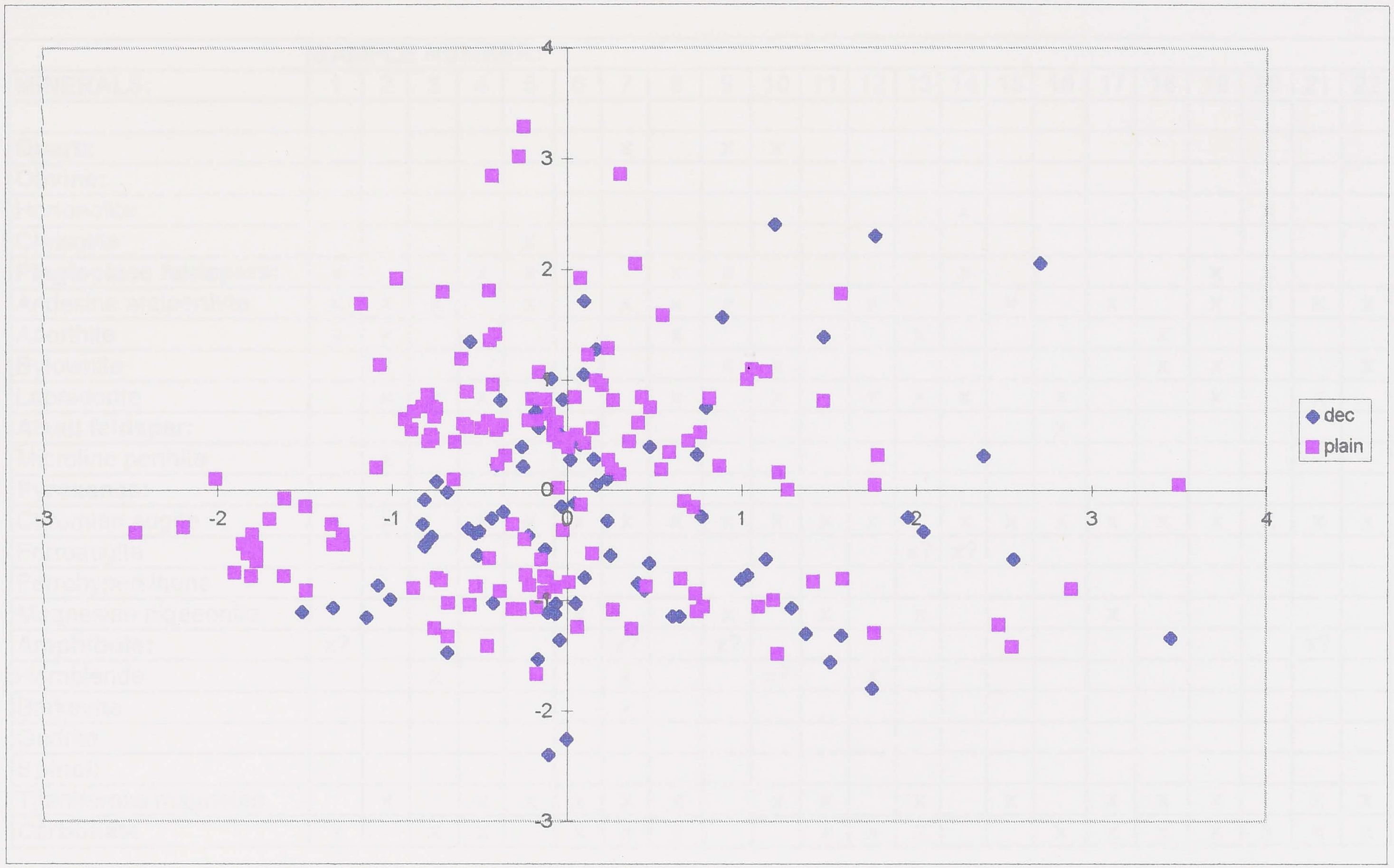


Figure A.4. CPCRU comparison for clay minerals of the Gilimanuk samples.

TABLE A. 2. CHEMICAL ANALYSIS OF MINERAL INCLUSION OF THE GILIMANUK SHERDS

	SAMPLE NUMBER:																						
MINERALS:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Quartz							x		x	x													
Olivine:																							
Hortonolite														x						x			
Chrisolite					x																		
Plagioclase feldspars:	x			x	x	x		x	x					x					x	x			
Andesine antiperthite	x	x	x		x		x	x	x			x			x		x		x	x	x	x	
Anorthite	x	x						x					x					x					
Bytownite		x							x	x								x	x			x	
Labradorite		x	x	x	x			x		x		x	x	x		x			x		x		x
Alkali feldspar:																x							
Microline perthite		x																					
Pyroxenes:																							
Chromian augite	x	x		x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x
Ferroaugite													x?	x?									
Ferrohypersthene				x																			
Magnesian pigeeonite						x			x		x		x				x						
Amphibole:	x?						x?		x?												x?		
Hornblende			x				x			x?		x											
Barkevite							x																
Gedrite																							x?
Spinel:																							
Titaniferous magnetite		x		x	x	x	x	x		x	x		x		x		x	x	x		x	x	
Carbonate	x		x	x		x	x	x			x	x	x			x	x	x	x	x	x	x	x

x : present
x? : uncertain

analysis of the clays we know that only one source of clay was selected, and from chemical analysis of the minerals, with the exception of the calcareous inclusions, all the other minerals are the same (volcanically derived).

This analysis is supported by the result of a geomorphological investigation done by Sunarto (1993), that indicates that an eruption of Gunung Kelatakan (a Lower Quarternary volcano, not active at present) formed the Gilimanuk soil layer and that of adjacent regions. Sunarto (1993) stated that clay sources were absent in Gilimanuk, but soil with a high kaolinite content is available at the foot of Gunung Kelatakan, about 15 km from the site. In this regard, while the calcareous beach sand filler was available in Gilimanuk, it is quite possible that the uniform clay paste was obtained from another location.

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ABBREVIATIONS

AP	: *Asian Perspectives*
BIPPA	: *Bulletin of the Indo-Pacific Prehistory Association*
BPA	: *Berita Penelitian Arkeolog*
JMBRAS	: *Journal of the Malaysian Branch of the Royal Asiatic Society*
PIA	: *Pertemuan Ilmiah Arkeologi*
PIA	: Asosiasi Prehistorisi Indonesia
Puslit Arkenas	: Pusat Penelitian Arkeologi Nasional
REHPA	: *Rapat Evaluasi Hasil Penelitian Arkeologi*
RSPAS	: Research School of Pacific Studies
VKI	: *Verhandelingen van het Koninklijk Instituut voor Taal-, Land- en Volkenkunde*

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